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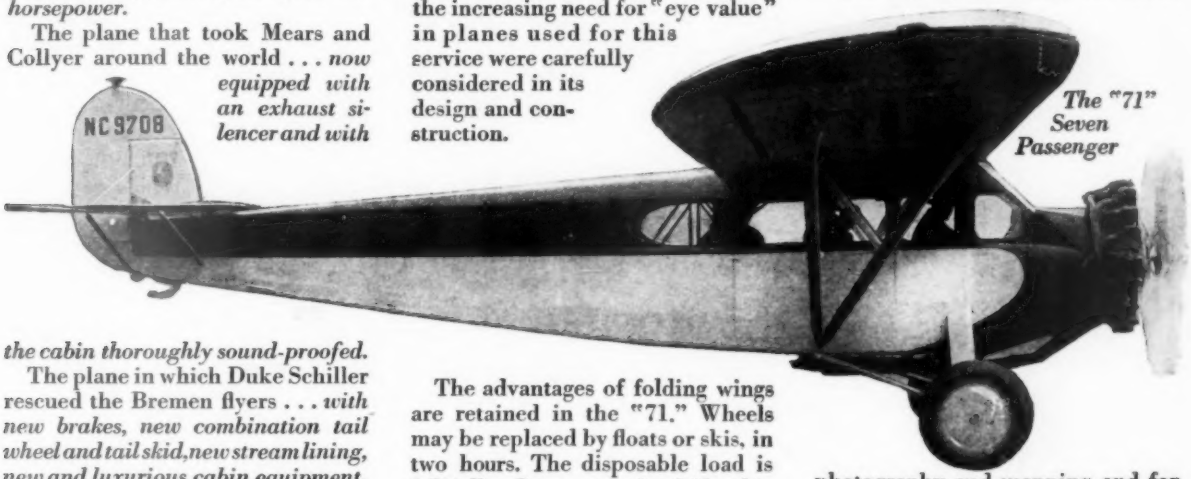

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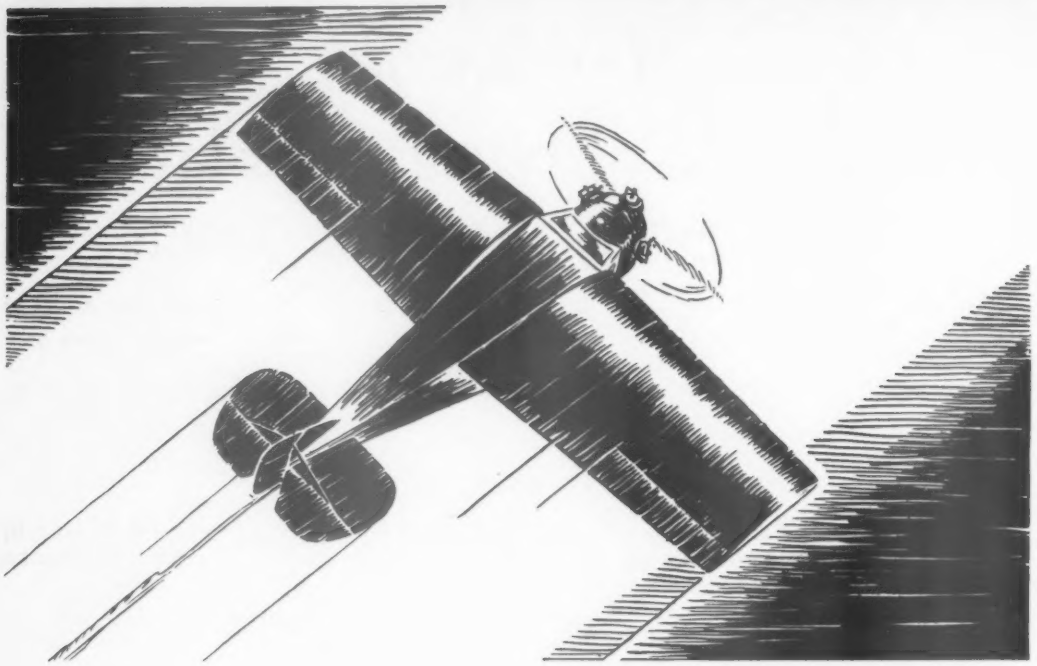

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Colonel Arturo Ferrarin

Colonel Arturo Ferrarin has been designated "the best aviator in the world in 1928" by the International League of Aviators. The distinction was conferred last year on Colonel Charles A. Lindbergh. Colonel Ferrarin was chosen for the honor this year by a margin of two votes over Captain Charles Kingsford-Smith, commander of the Southern Cross. Carl Ben Eielson was awarded the 1928 First Flyer trophy for the United States.

Accompanied by Major Carlo Delprete, Colonel Ferrarin flew from Rome to Natal, Brazil, July 3-5 last year, in a non-stop flight lasting 51 hours and 59 minutes. The distance is estimated to have been 4,417 miles.

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With them will act R. Stuart Murray, Advertising Manager, and Harley W. Mitchell, Editor of Popular Aviation and Aeronautics.

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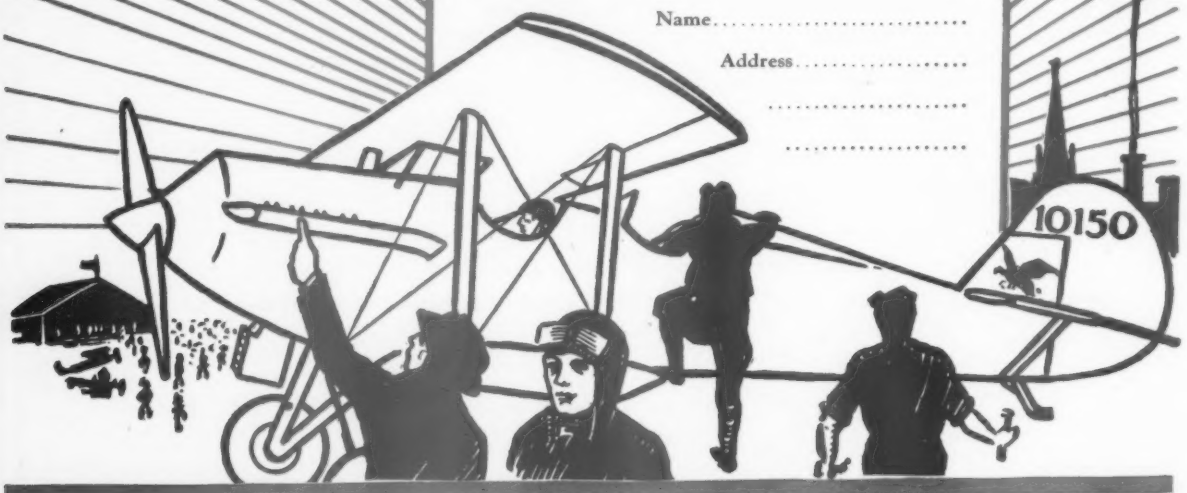

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42nd Street, looking west toward the Hudson River from Lexington Avenue.

Aerial Tax Assessing

By Kent Sagendorph

Special Representative, Fairchild Aerial Surveys, Inc.

SEVERAL technical treatises have been written on the value to a commonwealth or municipality of having its picture taken from the air. There is only one objection to setting forth here some of the data which has thus been collected; namely, the reader would trip over some of the eleven-syllable words before he had waded through a paragraph. They concern themselves mainly with the purely technical side of the thing, and are considered clever by engineering societies and stiff-bosomed city commissions. But to the average air-minded citizen of the country, these documents read like the thrilling tales chiselled on the sides of an Egyptian obelisk.

Let us, therefore, forget what goes on in the meetings of the valuation board, and glance at the tax map itself. The business of making aerial surveys for tax equalization has taken on huge proportions in the last year or two, and is now one of the chief peace-time uses for that formidable weapon of war, the aerial camera. Its wide acceptance and general use by leading cities and obscure rural townships indicates that a whole new technique of tax valuation is being developed which is accomplishing three new and much-sought results—it doesn't forget a single square inch of taxable property; it shows every structure to scale and in its exact relationship with every other structure, and it effectively stops all complaints from taxpayers about being unjustly assessed. With a foundation like this, it is a simple matter for the valuation board to then proceed with the work of getting the correct amount of tax on each piece of property.

The tax-map looks like no other aerial map. It is not built-up into a "mosaic," but the corrected prints, which have been adjusted for deviations in scale, tilt of camera, etc., in the laboratory, are enlarged to exactly a scale of one inch to one hundred feet. It is usually flown at a height of a mile and a half, using a special mapping camera and the best of flying equipment. At this altitude, each 7x9 photograph shows an area of over a hundred acres. These may be enlarged for use by some local official or for publication, to any convenient size up to 24 by 30 inches. The valuation boards and assessors then carefully mark the boundary lines on each piece of property; the owner's name is listed thereon, and

the acreage it occupies. A photograph two feet by two and a half feet on a scale of one inch to fifty feet showing over a hundred acres of property is a map which everyone can understand and examine with ease and clarity.

This, then is the theory governing the construction of a tax map. In practice, the aerial method differs considerably from the ground method, and furnishes several noteworthy improvements. Everyone is familiar with the old-time surveying party; with the rodman holding his pose like the Statue of Liberty while the engineer peered through his transit and executed peculiar motions with his arms. They would set up their tripod over a mark on the sidewalk, and put on their performance. Then they would pick up their apparatus and move to a new spot, and play to a different audience. There was no charge for this, and it was usually well received by all the small boys in the neighborhood. While the main show was going on around the transit in the street, the rodman would shoulder his decorated pole and walk into the very center of a new garden; whereupon he would set it down and lean against it with bored indifference while the indignant householder voiced his opinion of surveyors in general. When the party returned to the office in the evening, they had usually surveyed several blocks and been cussed at by everybody living in the vicinity.

Today, there is very little to see from the ground. If you have good vision, you may be able to make out a tiny speck in the clouds which moves across the city in a monotonous, methodical sort of way. This is the modern surveying party. A short time later a representative of the city calls on the property owner, and presents a vertical photograph of the surrounding district. The only connection the taxpayer has with the making of the survey is the marking of his property lines on the print with a pencil. He proceeds to forget it until his attention is called to the matter by the large headlines in his local paper, announcing hundreds of pieces of property discovered which had been left off previous tax lists.

The comparative value of the aerial survey versus the ground variety could be decisively shown by statistics, but for the present purpose let us quote a single statistic. There is nothing like a statistic to prove a point.

Water-front, business, and residential districts mapped for tax assessment.

The city of New Britain, Connecticut, is a good instance. By the old method of ground survey, this thriving city was required to spend $3,000.00 per square mile and consume four years in the making of a tax map, which showed an area of sixteen square miles. The Fairchild Aerial Survey Company, of New York, using the aerial method, furnished the city of Middletown, Connecticut, a photographic tax map showing 43 square miles at a cost to the city of $162.00 per square mile, and delivered the completed map within sixty days after flying. In addition, 1,896 pieces of city property were discovered which had been omitted from previous tax maps. The newspaper reports of the episode claimed that by means of this additional information the levy on personal property could be increased by $1,500,000.00, resulting in a gain to the city of from $45,000.00 to $60,000.00 in taxes. In a city the size of Middletown, Conn., this is quite a startling revelation.

The town seemed to be quite upset after publication of this interesting news. Merchants hurriedly revised their appraisal of stock and fixtures. A town meeting was called, attended by many large taxpayers, to consider the situation. Mill and manufacturing buildings, of which there had been 56 on the previous list, suddenly increased to 198. Forty-nine pieces of property on the main street had never appeared on any tax list. Dwellings, shops, garages, barns and sheds materialized on the tax records as if by magic.

"The method," said the Middletown Press, "and not the personnel of the local Board of Assessors is to blame. The assessors work for salaries of $800 a year and give three months of their time. They sit from October 1 to November 1 receiving the tax lists brought in by property owners. Those that are not voluntarily submitted they add themselves, together with a ten per cent increase. During November and December they check the lists and write the abstract book, which is completed in January."

An additional income of from $45,000.00 to $60,000.00, which was predicted by the Middletown Press, would not only pay for the aerial survey, but pay the assessor's salaries for several years. It would also eliminate a good many other financial problems connected with local taxation. Besides all the tax information to be gotten from their aerial map, the various other city departments are able to use it for tracing sewer lines, water mains, fire hydrants, studying traffic and many other municipal questions. In reply to a question from an official from another city, the users of one aerial tax map wrote:

"If you map your town and get a good job you would not part with those maps for the price of the whole revaluation."

In the November issue of this magazine appeared a short article by Willis Parker, entitled, "The Amateur Aerial Photographer," in which the author entertainingly described some of the ways in which amateur photographers could use their kodaks to take pictures from an airplane. Aerial mapping, however, is not one of them. The making of an aerial photographic map, for taxation or any other purpose, is a highly specialized field of endeavor. Mapping has a technique of its own, which is as complicated—as difficult to acquire as any other branch of engineering. As time goes on and the accuracy of the map increases to a point nearing perfection, the requirements are more rigid. It is now largely a problem in mathematics and civil engineering, using a special mapping camera and powerful airplanes designed for the pur-

XUM

pose. The cameras themselves require a high degree of skill in their operation, and one can count on his fingers the men now available in the country who may be entrusted with a mapping contract.

A modern aerial mapping camera is one of the most remarkable instruments devised by modern science. It has over a thousand parts, which are fitted together with the most painstaking precision, and a lens efficiency which is still the marvel of opticians. It weighs about forty pounds and costs in the neighborhood of five thousand dollars, so no noticeable attempt is being made to sell it to the flying public. It has a collection of dials, cranks, handles, gauges and lights which would drive the uninitiated observer into a daze, and looks about as much like the well-known kodak as a passenger locomotive looks like a handcar.

It is entirely automatic once it is in the air, but may be controlled by hand if desired. It has a little device known as the "intervalometer" mounted on it, which the aerial photographer adjusts before leaving the ground. When the ship is in position over the territory to be photographed, this apparatus begins to function, with the following results: at the desired instant it trips the shutter, starts an electric motor which re-winds the film, shuts off the motor when the right amount of film has been placed over the aperture, and six seconds before the next exposure is to be made it lights a small bulb placed near both pilot and photographer warning them to get ready. The pilot holds the ship as level and straight as possible; the photographer makes the final levelling adjustment to the camera, and with a whir the machinery comes to life and clicks the shutter again.

The writer asked one of the best-known aerial photographers in the country what was most desired to aid him in map work. He replied:

"A good book to read while we're getting up there and coming back. There's very little to do except get your overlap right."

That sounds easy, doesn't it? But getting the overlap right is what distinguishes a good photographer from a poor one, and is most certainly not the simple job it appears to be. The term "overlap" refers to the portion of ground that is photographed on two or more exposures. In most kinds of map work this overlap is about fifty per cent of the picture, so that a given object or point on the ground is photographed four times. This aids assembly of the map, and helps get it precisely to scale. In order to accomplish this in the air extreme care is required, skillful operation of the camera being about the most important single feature of the job.

The airplane which carries the camera must also be carefully considered. Aerial map work makes certain demands upon an airplane besides the ability to get off the ground and land again without cracking up. It must have high ceiling, for high-altitude photography; a lot of speed wherewith to operate from a base at considerable distance in the short time available, and above all, it must have stability. All flyers know what stability means, and some of them know what the lack of it means. Some ships are "ticklish," super-responsive to the slightest movement of control, and likely to jump around in bumpy air. A good photographic ship is one which will fly "hands off" under most air conditions, and which, when disturbed by varying air currents, will of its own accord right itself and resume level flight. There are not many production airplanes which possess these qualifications, and it is noteworthy of remark that the present Fairchild cabin monoplane is a direct outgrowth of this concern's quest for a suitable carrier for their flying cameras.

Improved and unimproved rural property. On this map one inch is equal to 1200 feet.

Clearly, aerial mapping is no job for the amateur. Years of experience have proved that it is impossible to take the average young draftsman or commercial photographer and develop him into an aerial mapper. But the phenomenal growth of the uses of aerial photography and the increase in business which is now being secured will result in the demand for aerial cameramen who may be relied upon, and there is no material from which to select. How, then, may a flying photographer be produced?

As in learning to fly, the old stand-by is the army. Nine governments now use the Fairchild Aerial Mapping Camera, which is used by nearly every civilian mapper also. But these cameras are so costly and complicated that they are out of reach of the newcomer in the game. The only place, therefore, to learn how to operate a Fairchild camera is in the army. The Air Corps maintains a photographic school at Chanute Field, Rantoul, Ill., where enlisted men are taught how to operate the camera in the air, and the developing and printing processes in the laboratory. They learn the whole trade by actual participation in it, and then are given ratings and sent to various flying fields to practice it. These graduates of army photo sections now hold well-paying civilian aerial camera jobs.

Commercial aerial photography occupies a unique position in the aviation industry. Mr. Sherman M. Fairchild, the highest authority on the subject in the country, summed it up before the delegates to the International Aeronautical Exposition in Washington by saying that it was at once an integral part of aviation, and one of aviation's best customers. Aerial mapping is a separate profession, according to Mr. Fairchild, which should not be included among the functions of the aviation industry. Mapping is a customer of aviation; it spends many thousands of dollars every year for flying time, and contracts with operators of aircraft to furnish the flying services. It therefore helps the aviation industry by providing it with a source of revenue. But oblique photography is one of aviation's own children. It is as definite a function of aviation as the carrying of passengers. Any aircraft operator, with

How property is listed on an aerial map. In this case a survey was made for an electric transmission line, as shown in the map.

a little study, may materially increase his income by means of oblique aerial photography, which does not require the highly trained engineers and the expensive organization devoted to the production of maps. Almost every conceivable use is made of these obliques. This is a matter which most flyers might do well to consider, but the subject justifies a more thorough explanation than can be accorded it here.

The aerial tax map's contribution to aviation is mainly the volume of business which is contracted for with operators of aircraft, and the enthusiastic adoption of the map by the country at large. Every taxpayer who deals with an aerial tax map thinks about aviation while he does so. He goes home from the assessor's office commenting to himself on this new addition to the airplane's service to the public, and he is all the more ready to adapt the airplane to his needs when the opportunity is presented. The tax map, therefore, has a great publicity value for the aviation industry, in addition to the profits made by contracting for flying time. It puts aviation right on your doorstep, and proves its value to thousands of persons who had never considered the subject before. By saving money to the taxpayer, the whole industry has gained new friends. By keeping the aircraft operator busy, it has made more money. The aerial photographic tax map, therefore, should be accorded a wholesome recognition by everyone interested in the progress of aviation in the United States.

Fairchild Aerial Mapping Camera, with intervalometer. The film is so highly sensitized it must be kept on ice until used.

The Small Airport

A QUARTER-CENTURY ago the Wrights first flew but it is only now that flight is beginning to be applied to the everyday purposes of man. More than two decades passed before the claims and arguments of the pioneers met fulfillment. They had the vision.

We must have vision today. If the airplane is to meet all the requirements of life its use must be surrounded with no more unusual unnecessary conditions than those incident to other transportation, such as the automobile or power boat.

In the old "grass-cutting" days pilots taught themselves to fly and they needed great fields in which to run and turn. Nowadays piloting is taught in the air. The field is used only for landing and taking off.

The length of runs necessary in departure and alighting are ever growing shorter with better design. Brakes in common use today have reduced the alighting distance materially.

The demonstrations of taking off and landing on buildings and vessels in the early days, the standard practice today of the Navy with shipboard planes, and present-day designs for overhead air terminals on railroad yards and steamship docks indicate the decreasing size of airports.

Today's facts are offered in support. The landing and take-off runs of the planes of yesteryear, tabulated in governmental records, are surprisingly short. The trend of design and equipment points the way to the future.

If the airplane is ever to be of common service in air transport it must be easily and quickly available to the traveler and to the shipper of goods. Its terminals must be as convenient to city centers as the docks and railroad stations. Land close to the heart of population is very, very expensive and in the nature of things no more space will be acquired for air transport, or any other use, than is actually necessary—and, in the light of the trend of aeronautic science, no one can safely apply the standards of past decades to those of the future.

It appears perfectly consistent to venture the minimum airport, close in, for the near-future handling of air traffic, with the cheaper and larger outlying fields for service, repairs, storage and the other requirements of transport.

Typical boundary light fixtures for the municipal airport.

It is obviously uneconomic to first acquire the far-out field at its inviting price and subsequently find the in-town price all but prohibitive or in-town space nowhere existant.

The teaching of students will probably not be done at the small airport for reasons other than of those of its size. More efficient and more safe design, brakes, adjustable propellers, perhaps launching

(*Continued on page* 105)

XUM

Symphonies of the Sky

By M. Luckiesh

Director Lighting Research Laboratory, National Lamp Works of General Electric Company

ALTHOUGH the sky is of interest and meaning at all times there are occasions when the effects are so strikingly full of movement and color or follow each other in such powerful moods that they can best be described as symphonies. It does not detract from the beauty and the impressiveness of these displays to know the reasons and meanings. Indeed, it adds an interesting phase to the pleasure of observing and studying the phenomena of the sky. To the aerial traveler who soars upward from one cloud-level to another, as the sun is setting, the scheme of coloring is simple. At an elevation from which he is able to look down upon some layers, along the level of another, and up at the remaining layers, the entire scheme of the painting of the sunset is laid bare.

The arrangement of colors upon Nature's palette in this case is elementary. These colors, however simple, are intermingled by reflection and strengthened by contrast. They are ever changing owing to cloud movement and to the sinking of the sun to and below the horizon. Thus the striking quality of mobility of form and of color is added to this great stage setting whose magnitude dwarfs man-made spectacles into insignificance. Often the colors flash vividly from one cloud layer to another, gradually dimming along with the daylight like a diminuendo—a benediction to active day. In the afterglow when the highest haze is still bathed in sunshine while the earth is already in deep shadow, perhaps one finds time and feeling for reflecting upon these mighty symphonies. And then the stars begin to pierce the darkening veil of the sky—another mighty rendition. Finally, if one is so favored, the aurora borealis—northern lights—follows this tranquil prelude with its mysterious ghostly ever-changing streamers and curtains. Indeed, there are many fascinating symphonies of the sky wasted upon most persons, for they are understood and consciously seen by relatively few.

During most of the day there are two chief sources of the colors which the clouds display, namely, the sun and the sky. When the sun is high in the heavens its light is practically colorless or white. But this white light consists of light-rays of many different wave-lengths which separately produce within our visual organs the sensations of various colors. When raindrops separate these light-rays of various wavelengths we see the colors of the rainbow. All these rays simultaneously produce a sensation of white light.

The particles of dust in the atmosphere and even the molecules of the gases scatter the bluish rays more than those of other wavelengths. As a consequence the sky appears bluish because it is merely scattered sunlight. Thus we have a blue sky ever-present although often partially or totally obscured. The sunlit portions of clouds are really white because they are like snow illuminated by the white light from the sun. They appear a yellowish white owing to the contrast between them and the surrounding blue sky. The portions of clouds which do not receive direct sunlight may be somewhat bright due to sunlight diffused throughout them, but these also receive much light from the sky. Therefore, the shadowy portions of clouds often appear bluish. The varying proportions of sunlight and skylight not only model the forms of the clouds but give a delicate colorfulness to them.

When there are several layers of clouds moving at different velocities and sometimes in different directions, rather interesting mobile effects of brightness, shadow, and color are to be seen during the day. However, it is only when the sun is low—near sunrise or sunset—that the great colorful symphonies are to be witnessed. At these times color is added in another manner. As every aerial traveler knows, a haze covers the earth. Usually this extends to about a mile above the earth. It consists chiefly of dust, smoke, and water vapor. From this smudge the gorgeous colors of sunrise and of sunset are born. Usually where this smudge is relatively dense—but not too dense to obscure the sun—the colors are most powerful. The cross-country aerial traveler has noticed how cities are usually submerged in a denser haze than the re-

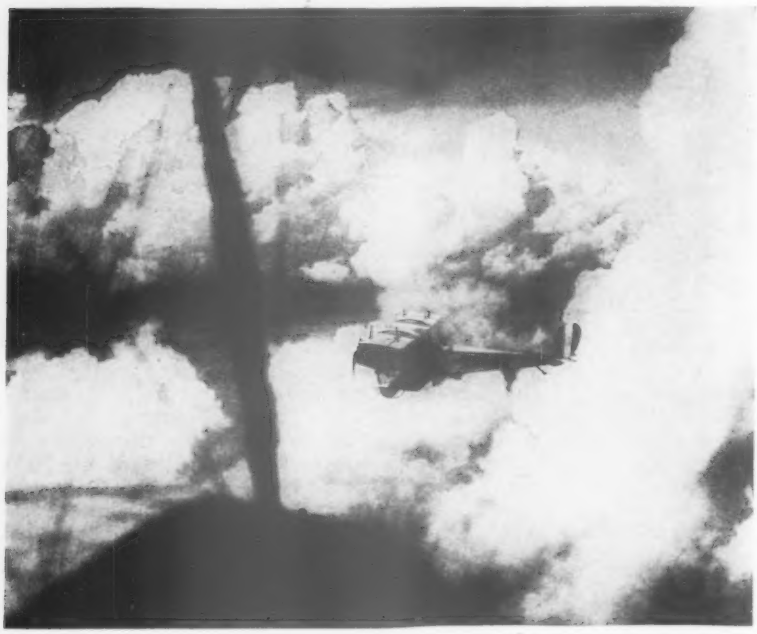
mainder of the country. Therefore, unless this smudge is too dense the sunsets will be more gorgeous as seen from cities than elsewhere.

This smudge haze is more transparent to the red, orange and yellow rays of sunlight than to the blue rays. When the sun nears the horizon its rays, passing obliquely through this haze, must travel through much greater depth than when it is high overhead. As we look at the sun through this great oblique depth of haze it is as though an orange-red glass were placed between it and our eyes. The change in the color of the light from the sun is from white, to yellow, to orange and to red as the depth of the haze increases. Therefore, clouds at various levels will receive sunlight which has passed through different depths or densities of this haze, with the result that they are of different colors.

Near sunrise and sunset the intensity of sunlight reaching the earth and the clouds is also greatly diminished compared with the intensity of the light from the sky. Therefore, the amount of bluish light from the sky becomes comparable with that from the sun, with the result that this bluish light added to the red and orange of sunset in various proportions creates the family of purple colors —pink, magenta, mauve, lavender, etc. Thus we have seen how the colors of sunrise and sunset are made. With clouds moving at different levels into the various sunset colors and moving into shadow and out, with the sun steadily sinking and the light from the blue sky and that reflected from one cloud to another continuously varying, we have an infinite variety of color. This, then, is the mechanism or the components of the sunset symphonies.

It should not dull the beauty of sunsets to know that the colors are born in the smudge of earth-haze. Without the atmosphere the blue sky would be replaced by inky blackness in the daytime. Without the earth haze even the delicate pastel shades of the clouds low down in the sky at noon would disappear and the clouds would appear as boldly against the deep blue as those in the zenith. Without this foreign matter in the atmosphere twilight would be brief and the glorious afterglow which is sometimes seen after sunset would not appear.

When the sun is setting blood-red at the earth's surface an aerial traveler at an altitude of two or three miles sees the color-scheme spread out before him. The lowest clouds are tinged with red and the next higher are of an orange tint. Those of his level are a brilliant yellow and the wispy cirri two or three miles above him are still bathed in the white light of the sun. From his position the sun is not yet setting, though viewed from the earth it is already touching the horizon. As he watches from his aerial lookout, he notes the sun gradually becoming redder as it approaches the horizon, which he can barely distinguish owing to the oblique depth of the haze. The lowest clouds gradually lose their reddish tint and as their crests are tipped with red their bases are already immersed in deep purplish shadow. Only a few moments this lasts, for the sun is seemingly proceeding on its eternal journey. The blood-red is now replacing the orange of the clouds next above the lowest and the orange have moved up to replace the yellow of those at the airman's level. The high cirri are now beginning to assume a stronger tint of yellow. This succession of colors is moving upward as the moments pass.



Flying through a sunset sky one sees the symphony of color at its best.

The earth is now in deep shadow. The low clouds are dark and coldly blue because they are now faintly illuminated with the bluish light from the sky. For the observer at the earth's surface the sun has set several minutes ago and the sky shows a succession of delicate tints from red at the horizon through orange, yellow and green to blue at the zenith. The aerial observer also sees these but they are more delicate tints to him. As the moments pass, the aerial observer sees the red sun touch the horizon and the clouds about him become reddish. Those below are deepening in shadow and the fibrous wisps far above are a salmon pink. The latter are bathed in orange light from the sun and blue light from the sky. The watcher down on earth is now in twilight; the sun's glow in the west is fading and the zenith sky is fretted with golden cirri.

The symphony goes on—a tranquil trailing diminuendo. It is a benediction. Birds have quieted for the night and Nature is asleep. Or in the city the night lights begin to emphasize their presence, but these symphonies are best away from the pulsating life of the city. For the aerial watcher above, the sun has set and below him is a cold, deep shadow. Some of the clouds about him are still bathed in the reflected glory and the high clouds burst into red for a few moments. Then the sun leaves them and the airman drops toward the shadowy earth. When he lands the night lights burst forth. He looks upward at the faint pinkish glow diffused from the zenith. This is the final farewell of the sun for the day. The twilight limit about fifty or a hundred miles above him is still bathed in the sun's radiance.

The duration of twilight is ordinarily subject to minor variations occasioned by the variable amount of haze and clouds in the atmosphere and by their distribution which depends upon the winds, vertical convection currents, and preceding weather conditions. For these reasons the morning twilight or dawn is usually of shorter duration than evening twilight. The duration of twilight has been found ordinarily to extend throughout the time required for the sun to travel an arc resulting in eighteen vertical degrees below the horizon. During an equinox, when the sun approaches the horizon vertically, twilight is briefest—other conditions being the same. Inasmuch as it requires seventy-two minutes

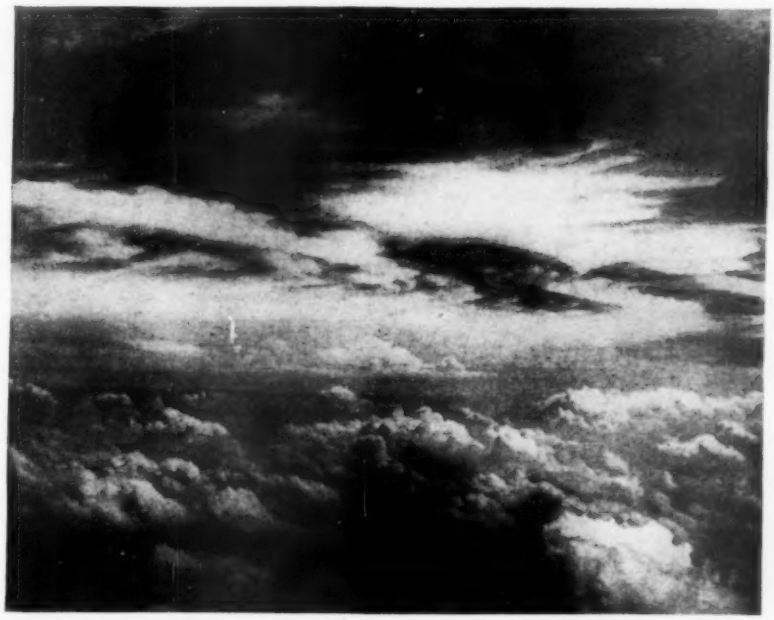
for the sun to travel these eighteen vertical degrees, twilight at that time lasts about seventy-two minutes. In those northern latitudes, where for certain periods of the year the sun is not depressed as much as eighteen degrees vertically below the horizon throughout the night, darkness is not complete for those periods. Inasmuch as the plane of the sun's apparent path varies in obliquity to the earth's horizon with latitude, different periods of time elapse for an eighteen-degree vertical depression; hence the duration of twilight varies with latitude.

The most splendrous sunset symphonies occur when there are many clouds at various levels moving rapidly. If a storm breaks up late in the day, the gustiness common to the trailing portion of a cyclonic area generally promises one of those powerful effects. Great broken clouds lie between the observer and the sun. Flying scuds pass from deep shadow and burst into flame momentarily to die out in the next shadow. Crests of the great bluish clouds are sprayed with color. To the gradual change of a tranquil sunset is added the agitation of moving clouds. Crescendos and rapid movements contrast power and activity with momentary quiet. Symphonies they are of many moods.

Even on a clear day clouds seldom fail to appear at the appointed time and place for sunset. The atmosphere has drunk much moisture during the day. As the sun approaches the horizon its heating effect greatly diminishes. Layers of air cool to the point that they cannot retain all their water-vapor. Some of the latter condenses and a stratus cloud is formed. Thus where there was promise of only the hazy sky to diffuse the sunset colors, some clouds come into being and are added to the stage setting. Perhaps on the horizon elsewhere a thunderhead or range of cloud mountains remains to catch some of the colorful light. Rarely does the sunset fail to be interesting. It only fails completely when great masses of clouds obscure it. Even then it does not fail the aerial travelers, for a few thousand feet above the earth the most beautiful sunset symphonies await him.

Not only is it possible for airmen to see sunsets when earthly observers are denied them, but it is possible to see a sunset, a sunrise, and another sunset all in the same evening. If one started aloft just as the sun appeared to touch the horizon and climbed in such a manner that his resultant vertical velocity was 1,000 feet per minute, the sun would begin apparently to rise at first and then gradually to set again. When an elevation of about 5,000 feet was reached at this constant vertical rate of climb, the sun would appear to be just touching the horizon again. These computations were made for the sun approaching the horizon vertically as at the equator during an equinox. Under these conditions in order to make the sun appear stationary at the horizon one must reach an altitude of one mile in slightly over five minutes; two miles in slightly over seven minutes; three miles in about nine minutes; and four miles in somewhat more than ten minutes. Considering the latitudes of the United States an aircraft would not need to climb as fast as 1,000 feet per minute for the first five minutes to see two sunsets with a sunrise between them on the same evening.

After watching one of the great sunset symphonies trailing off into the diminuendo of twilight, one is in a mood to contemplate further that great sky-



The sky at sunset is a vast color wash, infinitely subtle and delicate.

stage of Nature. As one watches the last lingering note—the faint flush of the afterglow—fade away, it is delightfully easy to fly on the wings of the imagination to ethereal regions where material wings have not traveled. The sky which is empty to most persons is really full of interest, beauty and even mystery. Its moods, its wonders, its limitless magnitude are motive-power for the imagination.

Stars have appeared and the sky is faintly illuminated like a bluish phosphorescence. What a tiny mote is the earth! Really how little of space has been visited by man—an insignificant layer near the earth. Out there in the sky are millions of places separated by inconceivable distances. These spaces man is traversing with his eyes and mind. Doubtless some day he will visit earth's nearest neighbors in rocket-driven ships of space. As one gazes at the night sky he wonders at this symphony of the spheres. Occasionally the cosmic dust of this limitless space is disturbed for the briefest moment by an erratic meteoric traveler which has broken the bonds of methodic order only to suffer total destruction. There is a brilliant trailing flash as he enters the earth's atmosphere before he vanishes in the fires of friction.

But the methodic stars have guided man's travels for ages. Today, just as clouds offer both utility and beauty to men, so do the stars. To scientists they are stellar laboratories affording facilities for the study of atoms under conditions as yet not produced in man-made earthly laboratories. Man's eyes, reinforced with powerful instruments, are learning much that will be put to use on earth. The secret of atomic energy will be at least partially learned from the stars. This kind of energy would do much for motive power and would greatly extend the range and possibilities of flying.

Among the symphonies of the sky there is another—not rare but less common than sunsets, afterglow, and starlight. To us in the northern hemisphere, it is the aurora borealis or northern lights. As our imaginations take us upward from the earth past the cloud-region, through the twilight region, we reach this last visible phenomenon associated with the earth and its atmosphere. Doubtless this symphony of mysterious ghostly lights is visible at some place or other on the earth's surface at any time. Those in the southern part of the northern hemisphere see it rarely if at all. Its fre-

quency and splendor increase with latitude until it becomes common in certain regions at a latitude as low as fifty degrees. Of course a clear atmosphere and a cloudless sky are necessary to see it at its best. Most persons think that the aurora is a rare phenomenon but at all times in all latitudes the entire sky is glowing with a very faint greenish light which is now known to be associated with, or a part of, the aurora.

The aurora remained a great mystery until recently. Even now most persons consider it to be due to light reflected from polar snow or to some equally inadequate cause. The northern lights are most commonly seen as a glowing arch of greenish white light in the north or

Clouds in the daytime are instruments for a symphony of gold and blue.

of streamers shooting from near the horizon toward the zenith. In the better displays, the streamers stretch across the entire sky apparently to the southern horizon. Besides these there are horizontal rows of diaphanous draperies appearing as if blown gently by a wind. In the great auroral symphonies all these elements are ever-changing in form, location and brightness. For the most part the color is a ghostly greenish white, but pink and other colors also appear in tantalizing elusiveness. There is a mood quality to these symphonies which only the awesomeness and mystery and silence and lonesomeness of night can produce. And these are not as rare as most persons believe. Like the sunsets, we must look for them consciously.

The aurora was a complete mystery until relatively recently. It is now known that the streamers and other moving elements are in the region of very rarefied atmosphere 50 to 500 miles above the earth's surface. They occur with greatest frequency and brightness at an altitude of perhaps 60 miles. Here the air is rarefied to about one one-hundred-thousandth of its density at the earth's surface. The frequency of auroral displays has been observed to be quite in harmony with the number of spots on the sun. It is also known that if electrons—atoms of electricity—are sent through a rarefied gas the latter will glow. For example, if a current of electricity is passed through a glass tube containing neon gas at a very low pressure, the orange-red light now common in electric signs is produced.

Summarizing these and many other known facts led to the conclusion that the auroral streamers were caused by electrons shot from the spots on the sun. When these streams of electrons pass through the earth's atmosphere of proper rarity there is a characteristic greenish glow due perhaps to oxygen. The brightness of the streamers and curtains changes with the intensity of the streams of electrons and the paths seem to be what they should be under the influence of the earth's magnetic field. Thus we have the sun primarily responsible for the impressive auroral symphonies as well as those of sunset.

Thus the sky is the great stage where many symphonies are played. A few paragraphs and man-made words are quite inadequate to do them justice. They are to be seen and felt—not described. Those, who by habit are observing and by the kindness of fate and their own development possess sensibilities which feel the mood and charm of Nature, are fortunate indeed if their course or interest has led them into the aerial world. How intimate the sky becomes to them! How much greater their world grows! The sky belongs to them —this great symphonic stage. And the sky is more than the few vertical miles of atmosphere in which man flies. It extends forever and away—unlimited, though fathomable with eyes and imagination.

Glimpses behind the scenes may aid in awakening the consciousness to these sky-symphonies which are rendered daily and nightly. Dawn usually begins with a prelude of quiet colorfulness until the rising sun pours its liquid gold over everything. The day sky is full of moods —changing slowly or rapidly. Certainly some of these effects are of symphonic caliber. Then come the sunsets always colorful but varying over a wide range of movements and moods, arousing the whole gamut of emotions at one time or another. The movement may continue rapid and the display may continue exciting and powerful into the night. On the other hand the sunset usually fades into tranquillity—harmoniously merging with gentle diminuendo into the trailing, lingering note of the afterglow.

Then there is a quiet merging from afterglow into starry night—the brilliant symphony of the spheres. The long trailing flashes of meteors remind us that there is movement in that unlimited expanse. The clouds and the moon add their influence and break the monotonous brilliance of the starry setting. And then comes the auroral symphony—ghostly, mysterious, elusive and awe-inspiring—befittingly of the night.

Dawn comes, the stars leave, and day begins again. Another cycle? Yes, but not the same, for these great symphonies of the sky are ever different, never the same. They alone do much to relieve monotony. They make the days different—even the hours and the minutes. And after all, monotony is what we strive to escape. Therefore, those who look to the sky with an open consciousness and with an understanding of its many phenomena and respond to its many moods will find that much of the monotony of life has disappeared. And to the aerial traveler, whether on wings of reality or of imagination, the symphonies of the sky are great climaxes of an ever-changing panorama which is always full of interest, meaning, and beauty, and always awesome in its magnitude.

Emory "U" Aero Club

Aviation is catching on in the colleges of the south as well as at Harvard, Yale, Princeton and other northern universities. The most recent attempt at aero club organization in the southern colleges is the work of Messrs. Simmons, Barnett and Holladay of Emory University, Emory, Georgia, who are organizing a college unit under the sponsorship of The A. S. P. A.

XUM

Physical Tests and Their Relation to Flying

By L. H. Bauer, M. D.
Medical Director, Aeronautics Branch, Department of Commerce

WHAT bearing has such and such a test on my ability to fly is a question that is often asked or thought by many aviators. Is the physical examination of an airplane pilot a theoretical affair or is it really based on good reason, is another.

Let us briefly review the examination of airplane pilots and see if the tests really accomplish their purpose.

First of all come the eyes. Pilots generally recognize the importance of vision. Many war-time pilots emphasized its importance. One said, "Men with poor vision do not come back." Why do we not allow persons with markedly defective vision to fly if they wear glasses? The wearing of glasses under goggles is prohibited because it restricts the field of vision. In other words the flyer can see straight ahead but has blurred vision at the sides. He is like a horse wearing blinders. Furthermore, he is looking through two panes of glass which diminishes his vision perceptibly.

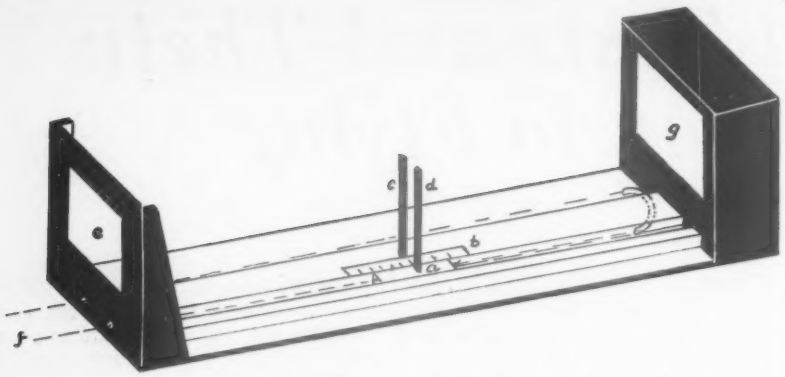
It is possible that he may wear corrective lenses in his goggles. There are difficulties here, however. Many types of correction cannot be ground in a lens the shape of that used in goggles. If the defect be very great, even though a satisfactory lens can be ground, it is easy to imagine what would happen to a flyer whose goggles became misted or smeared with oil as he was about to make a landing, if he took off his goggles and had so little vision that he could not see the ground. Many pilots have been killed because they had poor vision.

Next comes depth perception or the ability to judge distance. Pilots must constantly judge distance in landing and taking off, from the ground, trees, buildings, telephone poles, wire, etc. Accurate judgment of distance is essential in formation flying also. Now what relation has that apparatus with the two rods which the applicant tries to adjust while looking through a window in the front end of the apparatus, to landing a plane? It has this relation. The ability to judge distance depends on several physiological factors plus a certain amount of experience. This applies to the judgment of distance under any circumstances. This depth perception apparatus, with which all pilots are familiar, tests these factors on which the judgment of distance depends. It does not look like an airplane, it is true, but it tests those factors that enable you to handle an airplane satisfactorily so far as making a landing is concerned. Experience has shown that one's depth perception according to this apparatus is closely comparable to his landing ability.

Now what about those tests for eye muscle balance? These are the tests with the spotlight, the red-glass, the line of light, and the prisms. Do they have any bearing on flying? They do, most decidedly. The movements of each eye are controlled by six little muscles. The muscles of the two eyes work in pairs. They should be properly coördinated, but often they are not. When they are not, one of two things happens. Either the defect is so marked the person sees double, and learns to disregard the image seen by one eye, becoming for all practical purposes a one-eyed person, or he overcomes the lack of coördination by muscular effort. The former condition is easy to detect. Such individuals are what is known ordinarily as "cross-eyed" or "cock-eyed." The latter condition can be detected only by means of the tests which are referred to above. The importance of the condition is this. This constant muscular effort to obtain single vision is fatiguing. Fatigue causes headaches; headaches cause inattention; inattention causes carelessness. Marked fatigue results in the muscular power giving way and double vision results. There is still another point and that is this, eye muscle balance is concerned with the ability to judge distance. We frequently find an individual whose vision is practically normal but his judgment of distance is poor. On checking up we find that his eye muscle balance is defective. By a system of corrective exercises his defect is overcome and his judgment of distance becomes normal. In England during the war it was found that a large group of students had difficulty in landing a ship. Many of them were found to have eye muscle balance defects. 85% of these responded to treatment and had no further difficulties with landings.

We inspect the eyes externally to see if there is any condition that would interfere with clear vision or cause the eyes to water easily, thereby blurring vision at critical times. Then we inspect them internally by means of a light focused into the eye and a system

Testing the fields of vision with the perimeter. (Courtesy of Williams and Wilkins Company.)



Howard Depth Perception apparatus (Thorne). This is used in testing an applicant's ability to judge distance. (Courtesy of the Military Surgeon.)

of magnifying lenses. This tells whether or not there is any disease of the deeper structures of the eye which would interfere now or later with vision.

The pilot is then given a little card to read to test his near vision, or his power to focus his eyes. The pilot must focus from far to near in order to read his map and instrument board.

He is next given a book with some colored plates with numbers woven into the background. If he has normal color vision he can read them correctly. If he has not he cannot read them. His knowledge of colors has nothing to do with this as he is not asked to name a single color. Color vision is important because the flyer must detect navigating lights, airdrome lights, colored signal panels and lights; his map is often printed in colors; and what is even more important, the different shades of brown and green seen on the ground indicate the character of the terrain and aid in picking out an emergency landing field. The last factor to be tested so far as the eyes are concerned is the size of the visual fields for form and color. Form may be tested by your looking in the eye of the examiner while he brings his moving fingers in from the periphery. The field for form and also for color may be tested by a perimeter, an instrument consisting of an arc, a central mirror or light on which to fix and a moving object brought in along the arc until the applicant can identify it. This tests his ability to pick up objects out of the tail of his eye while looking straight ahead, a rather important factor for a flyer. The color fields, if normal, show a normal retina, the sensitive coat of the eye. If defective they are often associated with a condition that makes it difficult to see at night.

So much for the eye. I think that all will concede that we have examined nothing that bears no relation to flying.

The ears, nose and throat come next in our examination. We examine hearing, which is not particularly important, but I think it will be agreed that the flyer ought to have enough hearing to hear his mechanic say "contact," and "switch off." We feel that the passenger-carrying pilot should be free from marked obstructive or diseased conditions of the ear, nose and throat. Exposure and fatigue make these worse and cause him to deteriorate physically. They may interfere with free breathing, and retracted ear drums may be ruptured by sudden changes of altitude, a very painful occurrence.

The constant changing of one's plane of equilibrium from the horizontal plane necessitates a normal sense of equilibrium. This used to be tested by a whirling chair. Now, we use a simpler test, consisting of standing on one foot, the other leg bent at the knee, eyes closed for 15 seconds. If one can do this, has healthy ears, and no disturbance of gait, he has no defect of equilibrium of any consequence. Such defects result in the flyer having difficulty keeping his plane on an even keel and easily becoming confused by spirals, banks and spins.

The general physical examination comes next. The applicant's history is of some interest, particularly in the case of certain diseases. For example, asthma is apt to cause the flyer to become suddenly incapacitated in the air. So-called sleeping sickness leaves the individual more or less lethargic and a slow reactor. Syphilis, unless definitely cured, may result in syphilis of the central nervous system—a dangerous malady. We ask about other diseases merely to call the physician's attention to a careful examination of the organs that might have become affected. For example, a history of rheumatism makes us suspect heart disease.

Structural defects, such as stiff joints, loss of extremities, etc., and disproportion between height and weight may result in inability to handle the controls of aircraft. One may go for years with a hernia and have no difficulty. Sud-

Testing for heterophoria (defects of eye muscle balance). (Courtesy of Williams and Wilkins Company.)

denly, without warning practically, it becomes strangulated. This can happen in the air as well as anywhere else and so we do not like to pass as a passenger-carrying pilot one who has a hernia (rupture). Diseases of the heart, lungs, kidneys, thyroid, etc., may cause sudden incapacity in the air and render the flyer a hazard to navigation as well as to himself and passengers. Pulse rate and blood pressure are important. They give us an indication of circulatory efficiency and indirectly of physical efficiency. The response of both to a simple exercise test is valuable, in that a poor response may mean chronic or temporary "staleness" or in some cases organic disease. "Staleness" is something flyers have to guard against. Many old flyers will admit they have passed through a period of staleness, due to too much flying, too little exercise, or too much dissipation. There is a loss of interest in work, sleeplessness (and when sleep does come on it is accompanied by unpleasant dreams), irritability, a few physical symptoms, such as breathlessness, a constant tired feeling, sweating of hands and arm-pits, blue looking hands and a falling off in flying ability. Such is an extreme case, of course, and we wish to prevent a flyer ever reaching extreme staleness as it is recovered from slowly and with difficulty.

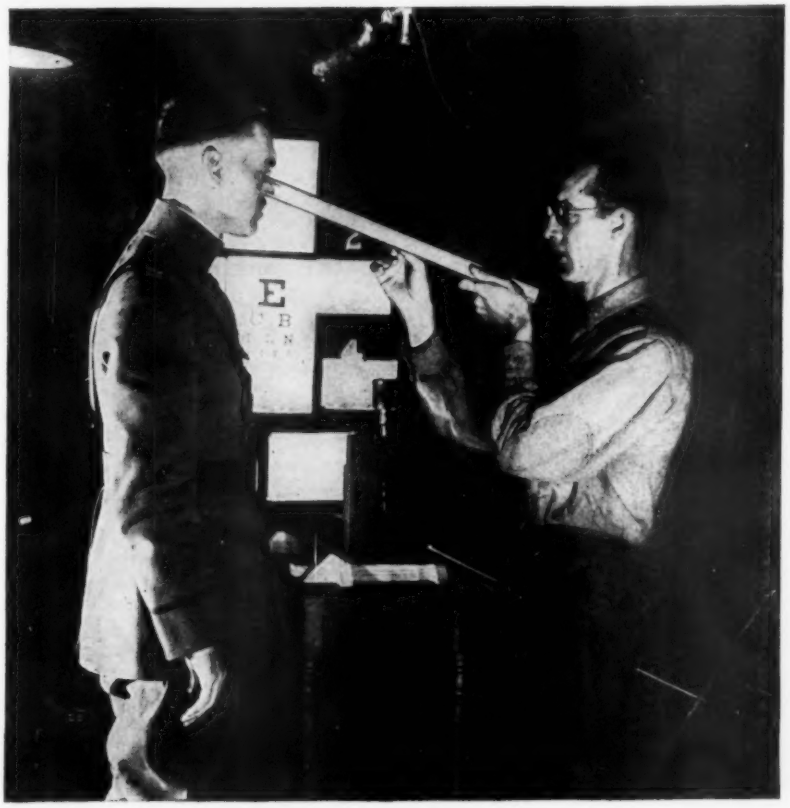
The examination of the nervous system helps detect staleness also. This is the system of the body subjected to the greatest wear and tear from stress and strain. The Army and Navy have found it the most important cause of grounding their pilots temporarily or permanently. Many questions are asked in this part of the examination which may seem farfetched and as having no possible connection with flying. These questions, however, are asked with a view to determining whether or not the applicant has shown a normal reaction to stress of any sort in his past life, and whether or not he has any traits or defects that would put him down among the nervously unstable. We hear much about students "freezing to the stick." This infers a lack of emotional control that is disastrous. We try to bring that out in our examination and eliminate such individuals.

When we disqualify a man we do not mean to say that he could not learn to fly or continue flying. What we do say is that the hazards in his particular case are increased over and above a reasonable amount and the Department cannot be responsible for vouching for him as a safe pilot.

We look on trained pilots differently from students and waive many defects that would disqualify students. This is because the most dangerous period—training—has been passed and their experience compensates to a certain extent for their physical disabilities.

One more point of importance, and that is, because a pilot passes his examination today, he should not look on himself as necessarily fit to fly every day for the next six months. He should keep himself in good physical trim by regular exercise and habits. Remember that minor physical ailments may be important in the air and develop into conditions serious enough to make him unsafe, if he neglects them.

Finally, let it be remembered that the attitude of the Department is to keep every pilot in the air, not out of it.



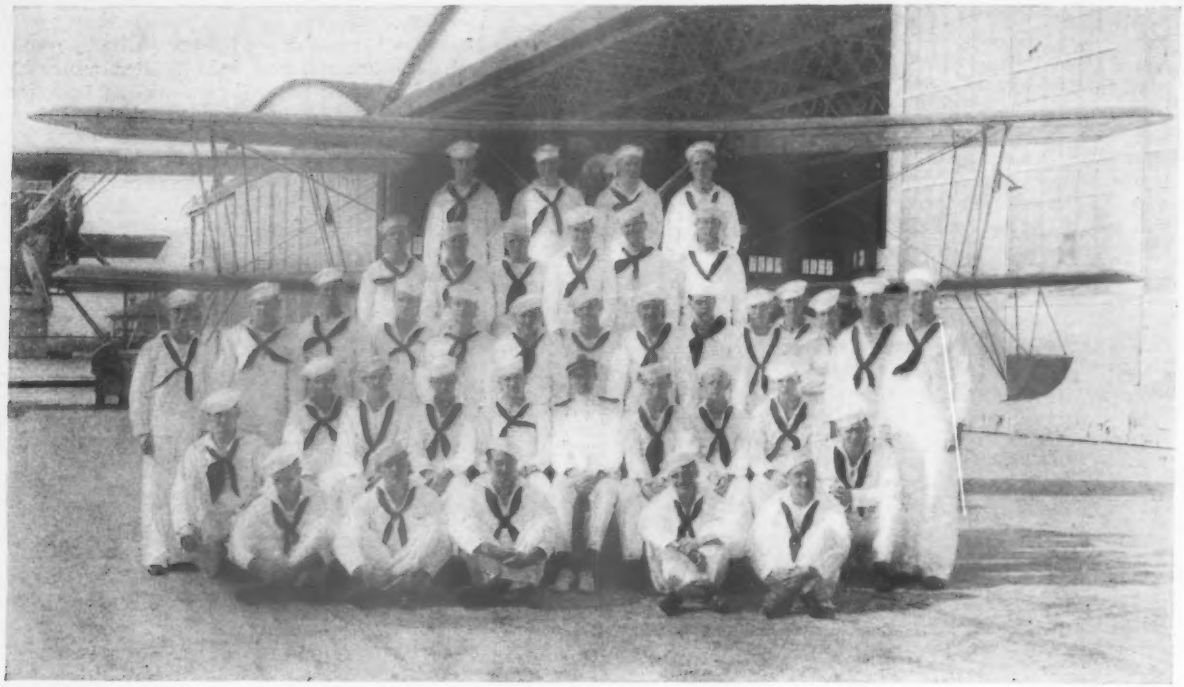
Measuring the angle of convergence. This test is also for eye muscle balance. (Courtesy of Williams and Wilkins Company.)

Club News

DURING the month of October, 1920, the Ogden Park Flying Club received a state charter as a not for profit corporation. At that time there were four members in the club. Since then the membership has increased four hundred percent and is continuing to increase in such a manner that the club is one of the fastest growing organizations of its kind in the Middle West.

Through the efforts of one of the members of the club, the faculty of the Englewood Standard Evening High School has installed a course in aviation. This course is being conducted by Capt. Ronald Nye, A. C. R., who is also a member of the Ogden Park Flying Club. The course takes the student through the history of early flights, and theory, construction and maintenance of the airplane. This course, as taught by Capt. Nye, has been recognized by the Bureau of Commerce. The course is free to anyone who wishes to take the instruction offered. At present it is the best attended class in the school. About thirty-five men and four women attend the class regularly. A new class is starting on February 11, and will meet on Monday and Wednesday evenings from 7:45 to 9:45 p. m.

The club has ordered a Waco-10 from the Midwest Airways Corporation for April first delivery, though it is probable that the ship will be brought in before that time. The club expects to lease a forty acre field in the near future to be used as a club flying field. A house on the field will be used as a club house. The officers are: P. Edward Prosperi, President; Byron Connett, Vice President; Emile DesPaul, Secretary-Treasurer, and Capt. Ronald Nye, A. C. R., Aeronautical Advisor.



Revolutionizing Naval Reserve Flight Training

By K. M. Painter

WHEN the present class of Reserve student officers completes the advanced training course at the Naval Air Station, Pensacola, Florida, previous methods of Naval Reserve aviation training will be branded obsolete and go the way of Liberty motors and F-5Ls. In sounding the death knell of past training systems, Lt. Robert Hively, who has been in charge of advanced Reserve training for the past two years, explains that: "The new syllabus comes as a result of two years' constructive endeavor to develop a Reserve Force which in all respects will be on a par with officers and pilots who complete the regular course at Pensacola.

"While all officers and personnel of the permanent Navy establishment have been receiving their training at Pensacola since 1914, Reserve training has been confined to Naval District Headquarters with advanced training at San Diego, California, and Hampton Roads, Virginia. Last year the two advanced stations were removed to Pensacola and a separate squadron established for Reserve training. Now this squadron goes by the board and Reserve students will be given training with the regulars at the rate of twenty-five each month after July 1, 1929. That means Reserve students will spend eight months at Pensacola, getting a definite mark in each of the four training squadrons, receiving instruction and solo time sufficient to warrant the designation of Naval Aviator when they have completed their training course."

The years passing since the close of the World War have marked a steady growth in the Air Force of the Naval Reserve, and the present revolutionizing plan—adopted February first—brings assurance of equality between the Reserve pilot and the regular pilot. The new syllabus for training Reserve student-officers with regular officers realizes the goal set by the Naval Reserve Flying Corps when it was reorganized in 1923. Prior to 1917 many States had their National Naval Volunteers—similar to the National Guard in the Army. With our entry in the World War, these State organizations were consolidated into a truly national organization, and formed —with the National Naval Militia—the backbone of our Naval Flying Corps during the war. Following the war, these Reserve officers were offered a commission in the regular Navy, provided they could pass the examination given officers of the regular Navy. Many accepted, and some of the best-known pilots now holding regular commissions were enlisted in this manner.

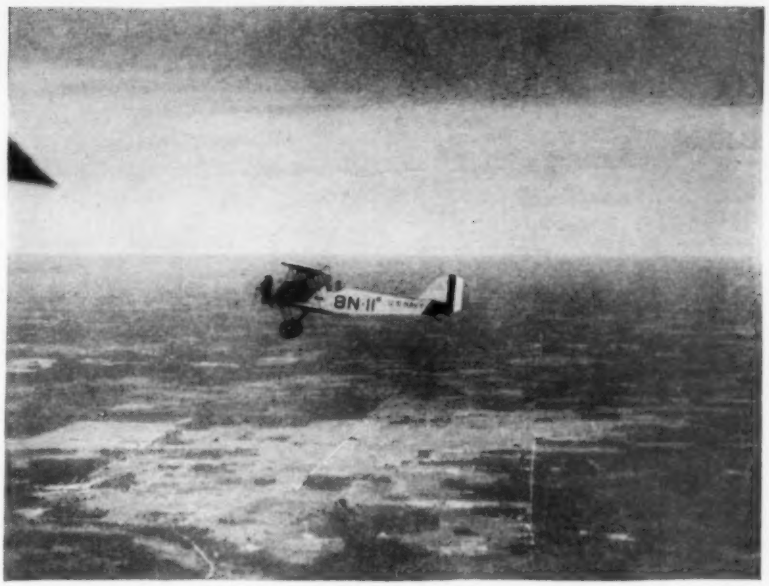
When the Naval Reserve Flying Corps was reorganized in 1923, the squadrons and divisions were allocated to the Naval Districts, with a Reserve officer in command of each unit. Of these districts, only four had facilities for giving primary aviation training—Squantum, Mass.; Rockaway, N. Y.; Great Lakes, Ill.; and Sand Point, Wash. Ground school lectures were given at these four primary bases, and applicants for Reserve aviation training were forced to go to one of these four districts for all preliminary instruction. In 1926 five more districts (and the District of Columbia) offered ground school courses, making a total of nine. Each of these districts was assigned a quota of students who might take primary flight training after satisfactorily passing their ground school training, and from the total number of

students taking the ground school course the quota was chosen.

If a candidate was selected from the ground school for further training, he was sent to one of the four primary bases for six weeks in the spring of the year, receiving $54 a month, uniforms, food and quarters—his status was that of enlisted man in the Naval Reserve. The primary flight classes were continuous, with 15 to 20 students in each. Once again the most apt students were selected and sent to San Diego, Cal., or Hampton Roads, Va., the following Spring for advanced training. In 1928 the advanced courses were all moved to Pensacola, Florida. About 25 students were in each of these classes. It is easily seen that many were eliminated before completing the course, when we consider that at present there are less than a thousand commissioned officers in the Reserve Air Force while the ground schools frequently have a combined enrollment far surpassing that number.

Completing the advanced training course, with a total of about 70 flying hours to his credit, the Reserve student-officer was designated Student Naval Aviator, and commissioned Ensign in the Naval Reserve. In 1926, Congress appropriated funds sufficient to include 50 commissioned Reserves in the aircraft squadrons of the fleet, for the purpose of giving them experience as Naval officers, and insuring them more than 200 flying hours, sufficient to warrant the designation of Naval Aviator. The same remuneration was allowed as that of a regular officer of like rank—$1,500 salary (base pay), $750 flight pay, $696 for food and quarters; a total of $2,946 for the year's training. The appropriation was made with the arrangement that 50 commissioned Reserves should join the fleet each year, which meant that a year's duty was all that was allowed each officer, and the first fifty went to their respective fleet-squadrons in 1927. In the future, this number will be increased to 100.

When the Reserve Student Aviators joined the fleet they were not qualified to fly any specialized type of plane. They had had a general training in a very modified and concentrated manner. Consequently, the squadron commanders of the fleet were not enthusiastic about having these student-officers join their forces. It meant that the fleet would necessarily devote some of its time to instruction, although the fleet had other business strictly out of the realm of a novice. The best that a student-officer could hope for with the fleet was a second-pilot's place which means little or no solo time, and is generally allotted to enlisted personnel.

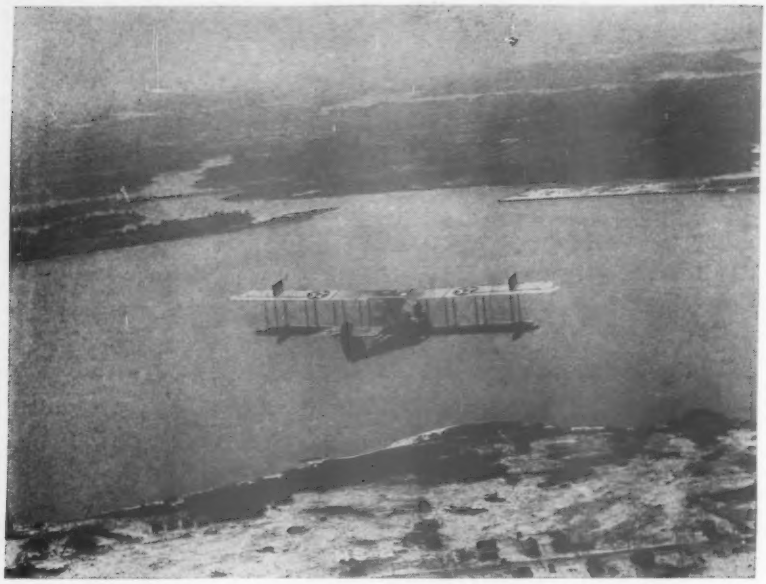


A Reserve student pilot soloing for the first time at Pensacola.

Primary training base at Squantum, Mass.

Superintendent of Naval Flight Training, Commander Charles P. Mason, is of the opinion that the new syllabus will qualify the Reserve students so that they will be of value instead of loss to the fleet. He anticipates that when a Reserve student has been given the full flight training at Pensacola, he will be welcomed as an officer by any squadron to which he may be assigned. "We are very glad," states Commander Mason, "to give Reserve student-pilots our regular training course, because then a Reserve officer will have a definite standing. When he performs active duty in the fleet he can be assigned duty in either a torpedo and bombing squadron or an observation squadron and can be a useful part of the organization." Though the Reserves will not get the combat course which entails training in the speedy Hawks, as Commander Mason points out, they will be qualified to join either of the other two divisions of the fleet. Only specially selected regular officers are given this course.

Though all this training costs the student nothing, (in fact he gets paid for every step from the ground school) the cost to the Government runs well over five figures. For every hour the student spends in the air, $23.50 is transferred from the Bureau of Navigation to the Bureau of Aeronautics, and this sum covers the cost of operation only. When we realize that the course has been



An old H S boat used for navigation instruction at Hampton Roads, Va.

jumped from seventy instruction-hours to two hundred, we can, in some measure, grasp the increase in first-cost to the Government. But this increase is considered a good investment, for now Reserve students are to be turned out as a finished product, and are qualified to hold responsible positions in the aeronautical organization of the Navy.

As outlined by Admiral R. H. Leigh, Chief of the Bureau of Navigation, there are four basic divisions of the new Naval Reserve aviation training: Ground school training, as a civilian; elimination flight training as an enlisted man of the U. S. Naval Reserve; primary and advanced flight training at the Naval Air Station, Pensacola, Florida, as an enlisted man of the U. S. Naval Reserve; one year's duty in aircraft squadrons of the battle fleet or the scouting fleet, U. S. Navy, as a commissioned officer of the U. S. Naval Reserve. The elimination training will cover a period of 30 days, with 18 flying hours, and only the most promising applicants will be sent to Pensacola for further instruction.

The Bureau of Navigation sets forth certain definite requirements for eligibility to the Reserve ranks. The applicant must be a citizen of the United States or of its insular possessions. He must reside in the locality of an authorized Naval Reserve aviation division or squadron. He must have finished his university training, be a senior in that university, or have the equivalent education which will make him eligible for the ground school training under the local university regulations. He must be qualified physically for enlistment and for flight. He must, at the time he is enrolled, be not less than 18 years of age, and not over 28 at the time he is commissioned. He must certify to his willingness to remain on active duty one year after receiving his officer's commission, or a total of 21 months, including the training period.

The ground school training has been expanded from 81 hours during the academic year, to upwards of 250 hours, beginning with the academic year which starts in the Fall of 1929. The ground schools are conducted either by universities located in the vicinity of the established bases, or by the commanders of the aviation squadrons or squadron bases, collaborating with an accredited educational institution, and the course is open to those eligible under local rules. It is from this group that selections are made for enlistment in the Naval Reserve, but during their ground school training they receive no compensation.

Students selected from the ground school are given physical examinations and, if qualified, are enlisted as seamen second class, U. S. Naval Reserve. They will be, in accordance with a schedule yet to be laid down, ordered to 30 days elimination flight training, to include 18 hours of flight, at such Naval Reserve Aviation Base as may be designated for that purpose. Uniforms are issued prior to reporting for training duty, and the student is placed by his orders in a pay status. Transportation to and from his home is furnished. It is anticipated that in this elimination training, approximately one-half of the students will be found qualified to continue flight training.

Continuing in a pay status, the successful student will be ordered from his elimination training direct to preliminary and advanced training at the Naval Air Station, Pensacola, Florida, where he will receive approximately 200 hours of flight training during a period of about eight months. He will enter the same classes that are conducted for officers and enlisted men of the regular service and be given additional technical schooling to enable him to pass a professional examination which he will receive upon the completion of his training.

After the candidate has completed his Pensacola training and his professional examination, and has been commissioned an Ensign in the Naval Reserve, he may be selected for one complete year of active duty with the aircraft squadrons

A Reserve student in training plane at Squantum.

of the fleet. Upon the completion of one year's active duty he may be appointed in the Fleet Reserve to fill a vacancy in an authorized Naval Reserve squadron. While in this status he may receive one day's pay for each drill or period of equivalent duty performed, not to exceed sixty drills or periods in any one year. If in the Fleet Reserve, he will be given the further privilege of performing fifteen days' training duty annually at a Naval Reserve Aviation Base. During this fifteen day period he will receive the full pay allowance of his grade. The Fleet Reserve is distinguished from the Volunteer Reserve by the fifteen day flight period which is given only to the Fleet Reserve. Any Reserve officer is entitled to join the latter organization provided there is a vacancy in the district in which he resides. When he is on the year's active duty with the fleet, though he may be a Fleet Reserve when he joins the squadron, he automatically is put on the Volunteer list, and through this, sometimes loses his place in his home district.

"The purpose of this Reserve training," according to Admiral Leigh, "is to provide a source of qualified aviators for general service with the Navy in time of war. Civilians are not selected and given flight training to qualify for a commission in the regular service. The Navy draws the regular pilots from among officers or enlisted personnel who are members of the permanent establishment and who have been selected for aviation training.

Three student officers at the primary base at Rockaway, N. Y.

"Students from the ground schools are also eligible for selection for the flight training outlined as a means to obtain a commission as a second lieutenant in the Marine Corps Reserve as Naval Aviator. The requirements for this selection may be obtained from the Major General Commandant, U. S. Marine Corps, Navy Department, Washington, D. C."

In reviewing the course which he was instrumental in inaugurating, Superintendent of Flight Training, Commander Mason declares that: "The new syllabus is a big step forward for the Reserve organization. In fact an additional 50 Reserves are to be offered the active duty year when they have completed the course, making 100 Reserve officers who will join the fleet in 1930. Under the new policy, the Navy holds out, to college men who may qualify, aviation training that is unsurpassed in its scope."

California Aero Clubs

The latest effort towards the organization of an aero club in Los Angeles, California, is that of C. R. Kranner of 434 East 38th Street, and associates. Mr. Kranner states he already has secured fifty prospective members for the new organization and a rapid development is looked forward to.

Eureka, California, will shortly have a very active flying club if the plans of Raymond Kirkpatrick of 910 North Street and associates are carried through. At a recent meeting the name Redwood Aero Club was agreed upon. Raymond Kirkpatrick was elected President and C. H. Carlson Secretary-Treasurer. The Redwood Aero Club is the first organization of its kind in Humboldt County and is receiving the cooperation of the local newspapers.

District	Address of Commandant of District	Squadron	Address of Squadron Commander	University
First	Navy Yard Boston, Mass.	VN-1RD1 VN-2RD1	Naval Reserve Aviation Base Squantum, Mass.	Mass. Institute of Tech.
Third	South & Whitehall Sts. New York City	VN-3RD3 VN-4RD3	Naval Reserve Aviation Base Rockaway, L. I., N. Y.	New York University
Fourth	Navy Yard Philadelphia, Pa.	VN-5RD4	Naval Aircraft Factory Philadelphia, Pa.	Temple University
D. C.	Commandant, Navy Yard Washington, D. C.	VN-6R	Naval Air Station Anacostia, D. C.	George Washington U.
Fifth	Naval Operating Base Hampton Roads, Va.	VN-7RD5	Naval Air Station Hampton Roads, Va.	None
Eighth	U. S. Naval Station New Orleans, La.	VN-8RD8	Naval Air Station Pensacola, Fla.	None
Ninth	U. S. Naval Training Station Great Lakes, Ill.	VN-9RD9	Naval Reserve Aviation Base Grosse Isle, Mich.	University of Michigan
		VN-10-RD9	Naval Reserve Aviation Base Great Lakes, Ill.	Armour Institute
		VN-11RD9	3009 Calhoun Blvd. Minneapolis, Minn.	University of Minnesota
		VN-12RD9	1908 Louisiana Ave. St. Louis, Mo.	Washington University
Eleventh	Naval Station San Diego, California	VN-13RD11	Naval Reserve Aviation Base Long Beach, California	U. of Southern Calif.
Twelfth	100 Harrison Street San Francisco, Cal.	VN-14RD12	Naval Reserve Aviation Base Oakland, California	University of Calif.
Thirteenth	Pier 1, Seattle, Washington	VN-15RD13	Naval Reserve Aviation Base Sand Point, Wash.	University of Wash.

Inquiries and applications for Reserve Training should be made to the officer located nearest the applicant.

Meteorology and Safe Flying

By Willis Ray Gregg

United States Weather Bureau

THE vital importance of an adequate weather service for aeronautics is no longer a subject for debate. It is universally recognized. Striking evidence of this fact comes in daily. Insistent requests, many of them in the form of demands, for more service are received with every mail from all parts of the country—from the lowly hamlet as well as the mighty metropolis. Caustic are the comments when these truly air-minded people are told—as many of them must, under present conditions, be told—that no funds are available for granting their requests.

A leading air mail contractor is authority for the statement that all of the troubles experienced by his company in the course of a single year were directly or indirectly traceable to weather. And, more recently, the president of the Transcontinental Air Transport Co., has stated that, in the maintenance of schedules in the proposed rail and air service from coast to coast, "everything will depend on the weather."

Other testimony to the universal recognition of the need for weather service is the inauguration during the past two years, by the Government, of such detailed service as funds permit on all of the commercial airways; and, quite recently, the organization by the Guggenheim Fund of an experimental, very detailed and intensive, service between San Francisco and Los Angeles.

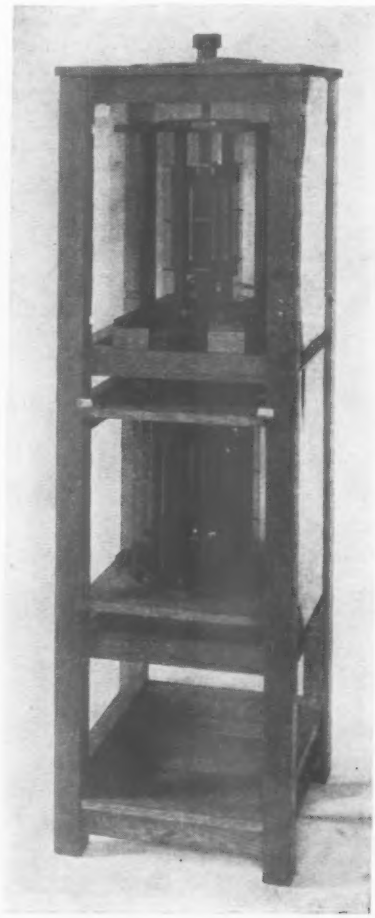
The importance of weather service for aeronautics may be considered from two points of view,—those of safety and efficiency. The latter point will loom larger and larger as time goes on, but the National Congress for Aeronautical Safety is devoting its attention to safety, and this paper will therefore be confined to that phase of the subject. In it will be discussed briefly the following topics: (1) present status of airway weather service; (2) needed researches; (3) how the pilot can cooperate; (4) how the air transport operator con cooperate.

Briefly stated, weather service for aeronautics, as now organized, may be said to be in the pioneer stage. We are trying out many different schemes. We hope and believe that some of them are along the right lines, but only time and experience can tell with certainty as to this.

Since 1926, when the Air Commerce Act was passed, service in greater or less detail, depending upon the amount of air traffic, has been organized along all of the commercial airways that have been established or recognized as such by the Department of Commerce. This new service is, of course, an extension of that already existing for the general public, which consists of twice-daily reports from all parts of the country and forecasts based thereon, these forecasts covering periods of 12 to 36 hours.

Although this service was very early found to be of a too general character to suit the needs of flyers, it did provide the groundwork or parent organization, and, as such, was capable of expansion at comparatively little additional cost. One of the first acts in making this expansion was to increase the number of what we may call "upper air" stations, that is, those at which observations are made of winds at flying levels. In all, there are now some 50 such stations, well distributed over the country, many of them being located at important points on the airways themselves.

Goniometer used at radio beacon stations where more than one set of guiding signals are to be transmitted.



Information regarding upper wind directions and velocities, although helpful in enabling the pilot to select the most favorable flying level, is not vital in the same degree as is similar information concerning conditions at the surface. It is this latter information that determines whether or not any flight at all can be made. Fog, low-lying clouds, excessive rain, sleet or snow, severe thunderstorms and very poor visibility render flying hazardous and impracticable. Not always will this be so, but in the present state of the art it is. Therefore, particular attention is given to these conditions, not only at the upper air stations but also at numerous places where observations are confined to surface weather. In all, there are now approximately 150 stations, most of them on the airways, from which such reports are available, when needed. Naturally, the time when they are needed is just before the pilot begins his flight. Accordingly, the reports are in general sent as short a time before the take-off as possible to still assure their receipt in time for use. Of course, the ideal system would be an exchange of reports all along an airway and from points on each side of it at frequent, regular intervals. But, at the present time, available funds do not permit this, and in some cases it is not yet justified, owing to the small amount of traffic that has thus far developed. However, there is now a three-hourly exchange of reports between the principal points on the New York- Chicago Airway, supplemented by special reports to fit the flight schedules from these and intermediate points on this airway. Moreover, as previously stated, an experimental service has been organized by the Guggenheim Fund between San Francisco and Los Angeles, and in this service frequent reports at regular intervals are interchanged between a large number of stations, both on and off the airway.

The reports themselves contain information regarding the general character of the weather, as clear, overcast, rain, snow, etc.; ceiling or height of low clouds; visibility; wind direction and velocity; temperature and pressure; and, when available, upper wind data. These reports go to the meteorologist who in many cases has his offices at the airport. They are used by him not only in giving

out information concerning current conditions, but also as a basis for short-range airway forecasts for the following one to five or six hours, depending upon the length of the flight. The utility of these short-range forecasts is becoming increasingly evident. It is no exaggeration to say that, in the early days of flying, pilots in general paid comparatively little attention to forecasts, unless a very long flight was contemplated. For short trips current reports were deemed sufficient. Many experiences, however, some of them involving considerable hazard and a few of them resulting in accidents, have shown very clearly that a condition reported as existing at any given time may, and often does change decidedly in the course of so short a period as an hour or so. Accordingly, on nearly all airways, the current reports are now supplemented by forecasts of probable changes in existing conditions, with particular reference to type of weather, ceiling and visibility.

It should be distinctly understood that neither in the current reports nor in the forecasts does the meteorologist tell the pilots whether or not they should fly. His function is, and must always be, only to describe the weather itself and give his opinion as to what it will be in the next few hours, leaving to the pilot or to others in control of the airways operations the decision as to the favorableness or unfavorableness of that weather for flight. The wisdom of this policy is apparent when one considers that the appraisal of weather conditions in relation to flight is to a considerable extent a relative one, depending on the experience and temperament of the pilots, the type of aircraft and the character of the service. Some pilots do not hesitate to start out in weather that others regard as offering considerable risk. Again, a strong head wind is or is not serious, depending upon the speed and cruising radius of the craft that is to fly against it. Finally, greater caution should be exercised with a passenger-carrying than with a mail or express service. These considerations introduce uncertainties with which the meteorologist, with his usually limited flying experience, is not equipped to deal. He indeed has his own quite sufficient responsibility of saying what the weather itself will be.

In addition to the current reports and short-range forecasts, the service to civil aeronautics provides forecasts covering periods of 12 to 24 or more hours. These are the general forecasts, augmented to include upper winds. They are of necessity couched in more general terms than are the short-period forecasts. In commercial aeronautics regular schedules must be maintained so far as possible. The operator wants to know today the likelihood of making a scheduled flight tomorrow. Particularly is this true in passenger-carrying service. If the probability is that no flight can be made or that there will be considerable delay, the prospective passenger can be so informed and can then, if he so desires, make his trip by train or bus. It seems likely that these longer period forecasts will become more and more important as the service develops.

All of this service, current reports and forecasts alike, is of little use unless it provides up-to-the-minute information to those needing it. This type of service involves two requirements: First, close contact between pilot and meteorologist; second, prompt and dependable means of communication. For the former it has been found by experience that the most satisfactory arrangement is to have the weather service organized and furnished right at the place where the pilot starts on his flight. And that place of course is the airport. Not only does the pilot thus get the reports as soon as they are received but he also is able to discuss them with the meteorologist. This matter of personal contact looms larger day by day as a prerequisite for the best possible service. When the weather outlook is decidedly uncertain (and alas! there are many occasions of the sort to plague the meteorologist) it is tremendously helpful to the pilot simply to talk the situation over with one who makes a special study of weather and its vagaries. It is now a regular part of the Government's policy to establish service at airports. This has been done in several cases and provides 24-hour service where flying is carried on both day and night. It will be extended to other important airports as the need develops and facilities permit.

But the meteorologist himself is handicapped unless he also receives promptly the reports from points along the airway and elsewhere on which he bases his bulletins and forecasts. And this means a dependable system of communications. Whatever the most satisfactory method may eventually prove to be—radio, telegraph, telephone, typewriter printer, or perhaps something unknown to us now, it will prove its adequacy for the purpose only by showing that it gets the information through more speedily and more dependably than does any other method. Very likely no one method will be used to the exclusion of all others, but one may be the principal, and the others auxiliary, means of communication. All types are at present in more or less general use in the service.

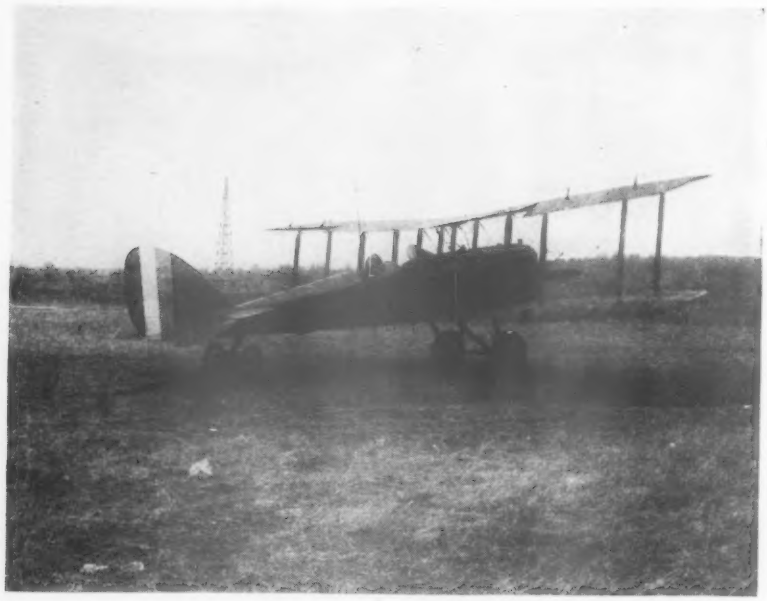
Experimental airplane at the College Park, Md., radio beacon testing station.

In addition to these ground communication systems there must be means of signalling to aircraft in flight. No matter how detailed a weather service, or how able the meteorologist, there will always be occasions (we hope their number will become progressively smaller) when conditions will unexpectedly change from favorable to unfavorable or vice versa after the flight has started. The pilot must then be informed, by radio if the aircraft is suitably equipped, or otherwise by visual means. So-called panel signal systems are now being tried

out at certain critical points in different parts of the country and much experimental work is also being conducted in developing suitable apparatus for ground to plane communication.

Such in brief is the present status of aeronautical meteorology, so far as its practical application is concerned. Although it is true that only a beginning has been made, it is believed that that beginning is along correct lines. If so, then future developments will be in the nature of marked extension rather than radical change. And that extension will include all sections of this country and its possessions.

Much has been learned in the course of the past years, concerning the general characteristics of the atmosphere. During the last 30 years our knowledge has been extended very considerably into the regions above the earth's surface. The general structure of the atmosphere is fairly well known up to 20 miles, well above present-day flying levels. And yet it can truly be said that an almost unlimited field for research lies open before us. The surface has scarcely been scratched. We are not so much concerned with general characteristics. What we want to know in more detail are the special occurrences, many of them of small extent but of serious import to the flyer.



10 foot vertical rod antenna, designed by the Bureau of Standards to displace the trailing wire method of aircraft radio reception.

Meteorological research has suffered greatly from indifference on the part of educational institutions and from the limited field available to those who might take it up as their life work. Happily, the situation is materially improving. With the development of aeronautics there is a growing demand for thoroughly trained meteorologists. To meet this demand, some of our leading colleges and universities are organizing courses in meteorology which will be of a grade similar to that of courses leading to degrees in other technical and scientific professions. It seems well, therefore, to consider some of the lines in which research is desirable as a means of increasing safety in flying. A few of the more pressing problems will be briefly discussed.

Visibility is the one great concern of the pilot. In proportion as it decreases his troubles increase. It reaches the vanishing point in dense fog. It is not for the meteorologist to try to get rid of fog. But he must study, in a detail that has never yet been attempted, the conditions that produce it, and those that dissolve it. True, we have this knowledge in a general way, now, but we can't apply it in individual cases. Otherwise, the forecasting of fog would now be a success, instead of the failure which it is, if we consider forecasting in anything like a specific way with regard to time and place. Similar study should be made of the occurrence of haze which becomes at certain times and in some regions so dense as seriously to affect visibility.

Nearly all pilots ask first for information on two elements, visibility and ceiling. Low ceiling simply means that visibility is cut off except at levels which are dangerously low for flying. Studies should be made that will enable the meteorologist to forecast the formation of low clouds with a goodly degree of precision as to time and area. Probably for such forecasts information as to upper air temperature, humidity and wind will be necessary.

This leads to the subject of new and improved methods of procuring upper-air data. At present our knowledge of wind conditions is derived for the most part from observations with small balloons, which can be used only in clear weather. There is urgent need of developing instrumental or other means for sounding the upper levels more or less continuously, and certainly at times when conditions are unfavorable or are becoming unfavorable. This seems to be a requirement particularly in the forecasting of conditions favorable for the formation of ice on aircraft. In this connection, it may be stated that a preliminary investigation of this subject will be made during the next few months.

Aside from fog, low ceiling, and ice formation, there are numerous subjects which are of less importance, but a better knowledge of which would nevertheless contribute very decidedly to greater safety in flying. Among them is the formation of the more or less violent disturbances, such as thunderstorms, line squalls, tornadoes, etc. These are usually not difficult to cope with, providing their occurrence is known, with a reasonable degree of precision, in advance. Much more needs to be known than at present is known concerning gustiness and vertical convection, both near the surface and at considerable heights. In fact, there is very little knowledge of the extent of vertical movements in the upper levels, such as those that were responsible for the destruction of the dirigible Shenandoah. Studies of this subject are of special concern in connection with the design and operation of lighter-than-air craft.

Finally, there is much work to be done along statistical lines. We have already gathered together an immense amount of data and we are adding to this supply daily. Most of this has been so compiled as to be quickly and conveniently available for study. There are many lines along which such study would be profitable. For example, an operating company must adopt a schedule that is as fast as possible and one that can be maintained a fairly large percentage of the time. There are two principal factors that determine what that schedule can be. One is the cruising speed of the aircraft employed and the other is the weather. The data concerning frequency of head and cross winds, fog, low clouds, heavy snow and sleet, etc., would determine what schedule could be kept, say 90 per cent of the time. Such studies have been made and published for two of the important airways. Data already available are sufficient for similar studies as to workable schedules for nearly all of

the airways. Naturally, the results can not be used to predict schedule maintenance for a short period, such as a week or a month. But for periods of a year or longer they would be (and in the cases cited they have been) found to be very nearly accurate.

We have already stressed the value of close contact between pilot and meteorologist. Let it be said at once, and the statement is based upon abundant experience, that the benefit is by no means one-sided. The pilot, in his discussions with the meteorologist, gets help that is immediate and direct. He profits by it that day and is then through with it. But the meteorologist learns from the pilot, if the latter be a good observer, many things that enable him greatly to increase the value of his own service. For one thing he learns the pilot's viewpoint—comes to know what he is most concerned about. In many cases in which the meteorologist is uncertain as to what the weather will be, the pilot tells him after the flight just what it was. This

Four foot wind vane of the type to be employed at the new weather stations for civil airways.

information often is available in no other way. The meteorologist finds out whether his prediction failed or succeeded, and is better equipped to handle the next similar case.

Oftentimes, moreover, a pilot brings information which is of great aid to another pilot who is about to start in the opposite direction over the same route. This information supplements, in a most helpful way, the data obtained from other sources.

Accounts of experiences in particularly bad conditions, for example, in a squall or while ice is forming, give the meteorologist valuable data for not only the day-to-day service but also for purposes of research.

In short, it appears that the pilot's contribution toward making the weather service play a dominant part in increasing the safety of flying will be more or less effective in proportion as he and the meteorologist discuss, frankly and sympathetically, their mutual problems. In this way each one profits and, more important, the safety and efficiency of flying are increased.

In many respects it is the air transport operator who is most vitally interested in this whole matter of safety. He must be able to guarantee a reasonable degree of it in the service that he operates; otherwise, his ledger will very shortly show a balance on the wrong side. He knows full well that, every time a crash occurs and particularly every time a life is lost, the whole program of the development of commercial aeronautics suffers a setback, entirely out of proportion to the seriousness of that single accident. It is the operator, therefore, from whom we should expect to receive the most effective cooperation in helping to make the weather service do its share in increasing the safety of flying.

He can do this in several ways. For one thing, he can arrange to have the meteorologist accompany the company's pilots on some of their regular trips. Experience shows that in no other way does the meteorologist obtain so clear a grasp of the pilot's problems as through actual flights in the different types of weather in which flights must be made. Poor visibility and low ceiling are terms that acquire a meaning then that they had not theretofore had. The two men learn, through these flights together, to talk a common language and can thus the more intelligently discuss their mutual problem.

The flights to which we have been referring are those in the operating company's regular schedule. Oftentimes, a pilot will start with less than a full load and it is then that provision might well be made for the meteorologist to go along. But, in addition, it is believed that special flights should be provided for during conditions of unusual interest. Such flights would not, as a rule, be cross-country, but would be made right at the airport, up to a certain desired height and down again. For example, suppose that conditions in late afternoon appear favorable for ice formation that night when a regular scheduled flight is to be made, but the meteorologist is uncertain because he doesn't know the temperature and humidity at flying levels. A short, special flight, 20 minutes in length perhaps, would secure these data and enable the meteorologist to tell with more certainty than he otherwise could whether or not a flight should be attempted. Occasional cooperation of this sort from the operator would, it is believed, contribute very decidedly at times to the safety of flying.

Finally, the operator can cooperate very effectively by instructing his pilots to give careful attention to the reports and forecasts that he receives from the meteorologist. He should also at all

Three-cup anemometer for use at the new weather reporting stations.

times be perfectly frank in his criticism of the service. If this service is not dependable, both the operator and the pilot owe it to themselves, to their patrons and to the Government, to report that fact to headquarters in order that action can be taken to bring about improvement.

It is proper, and it is also a pleasure, at this point to state that cooperation on the part of the air transport companies' officials, pilots, operators and others, has been and is whole-hearted and most helpful. Probably more appreciative attention is given to the weather service than to any other feature of the aids provided by the Government. And in return the facilities of these companies, almost without exception, have been made available to the meteorologists, many of whom now make occasional flights without cost to themselves or the Government.

Meteorology can help make flying more safe in the following ways: 1.

(*Continued on page* 104)

Aneroid barometer of the type to be used at the new airway weather reporting stations.

Taking Out the "Shimmies"

By S. R. Winters

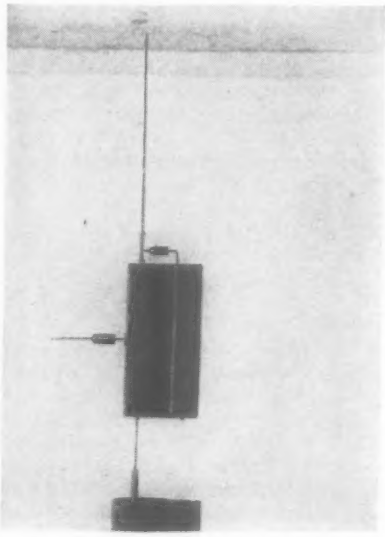
TO eliminate the "shimmying" effect from the wings of mechanical birds has been the object of tests undertaken by the Aerodynamical Laboratory of the Bureau of Construction and Repair, United States Navy. Expressed in less fantastic terms, the naval aeronautical engineers—A. F. Zahm and R. M. Bear—in reporting the results and conclusions of these experiments to the National Advisory Committee for Aeronautics characterized them as a study of wing flutter.

This Government investigation was prompted by obvious defects in the structural vibration of certain aircraft in which the safety of the craft was threatened and its performance handicapped. To overcome these obstacles, the experiments by Uncle Sam had for their objective the exposure of causes and the suggestion of remedies whereby the airplane designer could eliminate undue wing vibrations.

"Resonant flutter," conclude these Government investigators, "is not likely to ensue from turbulence of air flow alone past wings and tail planes in usual flying conditions." But the crux of the recommendation of the naval aeronautical engineers as how to avoid the shimmying effect of airplane wings is technically expressed in the following conclusion: "To be flutter-proof a wing must be void of reversible autorotation and not have its centroid far aft of its pitching axis, that is, axis of pitching motion. Danger of flutter is minimized by so proportioning the wing's torsional resisting moment to the air pitching moment at high-speed angles that the torsional flexure is always small."

This significant technical conclusion—suggesting as it does how to obviate airplane wing vibrations or oscillations—is of primary interest to the designer of aircraft. To the lay mind and to students of aeronautics, the apparatus employed in these tests is far more intriguing. For in this instance, as is frequently the case in scientific observations, unusual tests require novel equipment. These tests, interestingly enough, were not conducted in the air but on the ground. The 4-by-4-foot wind tunnel at the Washington Navy Yard served as the operating base for these experiments and a model of the MO-1 airplane as well as several simple models of airfoil structures were employed. On a miniature scale, the conditions of flight were simulated in this naval wind tunnel.

The tail vibration of this airplane in miniature was subjected to a particularly careful study and for this reason the tail unit was detached and individually mounted on an elastic knife-like support. This made it readily possible to vary the flexibility and adjustment of the tail unit. One side of this knife-like structure was inserted in a similar slit in the end of a rectangular brass web, which fitted into a vertical saw slot, purposely cut, at the rear of the fuselage. The rubberneck-like knife edge and the slitted end of the brass web holding it were cut into several coinciding sections, each equipped with a clamping screw. This slideable brass web, moving about in the fuselage slot, permitted of variable adjustments



Rigid plane surface, free to pitch and roll.

of the airplane tail unit under test—varying its height above its normal position. This afforded means for obtaining different values of restoring moment for a specified roll of the tail unit.

Fluffy, abbreviated lengths of silk and wool threads were employed as indicators of the airflow around the model airplane. The wool threads were selected as preferable to silk strands because of their extreme fluffiness and flexibility. As barometers to the relative movement of air in proximity to the airplane tail surfaces, the threads were fastened at one-inch intervals along a group of fine wires. The latter were stretched vertically an inch apart on a stiff wire frame, mounted across the wind in the position of the removed tail unit. The exploration of the air flow about the wings of this airplane in miniature and other units of the model was effected by a strand of wool thread—three inches long and secured to a fine needle on the end of a long ⅛-inch drill rod.

"Before mounting the complete model of the airplane in the tunnel," indicate the Government investigators in suggesting further preliminaries, "a brief test was made on the horizontal part of the tail unit alone, with elevators neutral, for reversible autorotation about the axis, since theory and experiment indicate that surfaces exhibiting this phenomenon at any fixed attitude to an air stream are susceptible of sustained rolling oscillations when flexibly hinged in this attitude about an axis along the stream."

Now, the vibration test proceeds, with the model MO-1 airplane in the wind tunnel, and the tail unit, with elevators fixed at zero position, mounted on the elastic knife-like structure. In this position, "no violent rhythmic oscillations of the tail surfaces were observed at any natural angle of attack," reports R. M. Bear of the Naval Aerodynamical Laboratory, "even though the stiffness of the elastic knife-edge was reduced to a very small value and a final test made with the tail unit freely hinged about the rolling axis.

"However, on allowing one or both elevators of the tail plane to swing freely from attached hinges, very violent rolling oscillations of the tail unit developed with the precipitation of pitching oscillations of the one free elevator, or of the two separate free elevators in opposite directions. In this vibratory rolling motion of the tail unit, the inertia of the free elevators always caused them to lie behind their neutral positions relative to the stabilizer throughout the portion of its path, thus causing the air pressure to be in the direction of the motion, and thereby amplifying and sustaining the vibration. When the freely hinged elevators were interconnected to prevent them from pitching in opposite directions no sustained rolling oscillations of the tail unit occurred."

Subsequently, a model of the Fokker FT airplane was selected as closely approaching the MO-1 type for exploring the flow of air and noting its reactions in this naval wind tunnel. "An exploration of the air flow about the Fokker model," we are informed, "showed a vibratory and turbulent flow from the roots and in the wake of the wings very similar to if not worse than that observed on the MO-1." "Therefore," it is concluded, "since the Fokker airplane was

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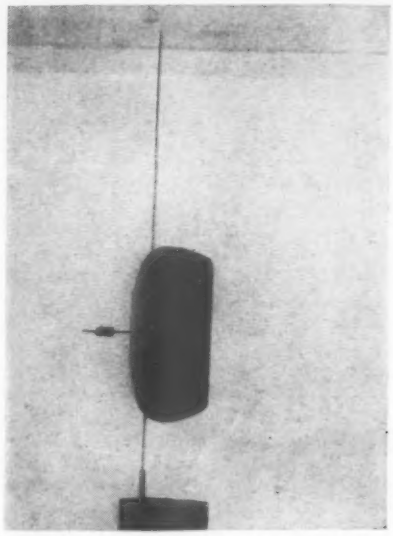


Rigid cambered surface free to pitch and roll.

known to have given satisfactory service without any serious structural vibrations, and the slightly disturbed flow noted on its model and that of the MO-1 in the vicinity of the tail surfaces seemed insufficient alone to produce any material vibration of these members when rigidly constructed, it was finally supposed, as originally suspected, that the rolling tail plane vibration on the MO-1 airplane was due, not so much to a disturbed air flow from the wings as to a relative weakness in spar structure which permitted a lateral distortion of the surface under its normal air pressures or inertia forces.

"As emphasizing the necessity for a stiff rear spar as well as a stiff forward spar to resist the distortion of thick tail surfaces of the MO-1 type, attention is here called to the National Advisory Committee for Aeronautics Report No. 118 describing tests for the pressure distribution over full-size tail surfaces in flight, which show thick-sectioned tail planes to be subjected to exceedingly large twisting moments about their axes and to receive their greatest air loading at the leading edge and tips."

The ills of the shimmying or fluttering of airplane wings having been diagnosed, the aeronautical doctors of the Naval Aerodynamical Laboratory prescribe the cure in the form of six prescriptions. They, scientifically termed "conclusions," are:

1. The airflow over the MO-1 model airplane, especially in the vicinity of the tail plane, is apparently not sufficiently disturbed to produce any marked rhythmic oscillations of the rigid tail unit flexibly hinged to the fuselage about its fore and aft axis. The type of airflow about this model is very similar to, if not better than, that about an analogous model of the Fokker FT airplane, whose wings or tail plane have never been reported to flutter in flight.

2. Excepting surfaces having forms or attitudes which exhibit the phenomenon of reversible autorotation, a surface that deflects under its received loads about an axis along the wind without otherwise turning or distorting will not be susceptible of sustained oscillations unless it be exposed to exceptionally turbulent, undulatory, or gusty airflow.

3. A cantilever surface, such as an ordinary wing or tail plane, which, under its received loads at small, high-speed angles of attack, experiences a differential deflection of its supporting spars, may, in perfectly smooth airflow, become susceptible of sustained oscillations, which may attain dangerous amplitudes as the surface approaches its no-lift attitude. The torsional deformation of surface entailed by a differential spar deflection is not so dangerous, however, at large, low-speed angles of attack.

4. The aerodynamic flutter of cantilever airfoil structures may be obviated by locating the center of mass of the system in or forward of the main supporting spar with the center of pressure aft of this member; or, more practically, by providing for sufficient structural rigidity to prevent any material torsional deformation of the surface under its received loads at high speed flying angles.

5. The vibration of the MO-1 tail plane results mostly from the large inequality of the ratios of stiffness to bending moment for the two supporting spars; wherefore these spars deflect unequally and entail sufficient surface deformation to precipitate sustained oscillations of the cantilever structure.

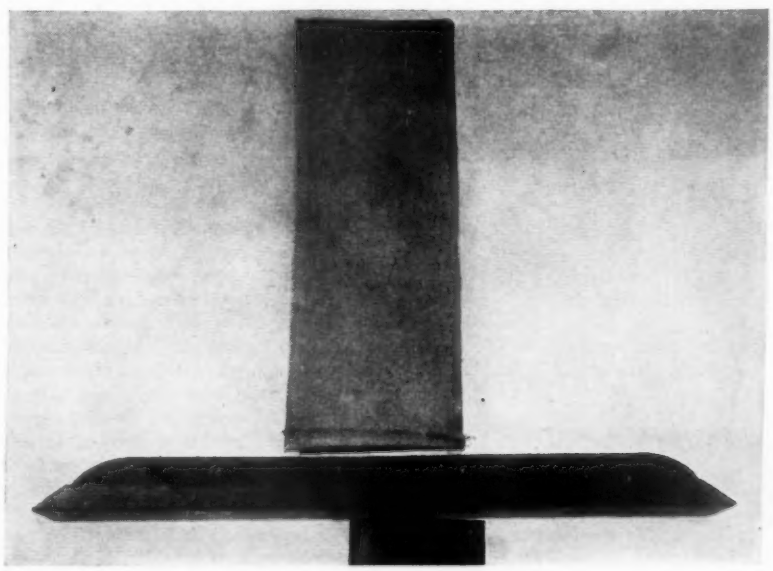
6. The vibration of the MO-1 tail plane may be economically minimized by giving spars the proper relative stiffness required by their bending moment ratios to cause them to deflect about equally under their received loads in normal high speed flight. Calculations for the spar stresses of this surface show that the rear spar should have somewhere around 1/3 or 1/4 the stiffness of the forward spar for minimum differential spar deflection, instead of 1/17, as was found present by spar deflection tests on the full-size MO-1 tail plane.

With the stiffness of the spars correctly proportioned to their received moments it is possible that the torsional rigidity of the surface supplied by the connecting ribs and covering will permit the use of a less stiff forward spar than at present, thus lowering the weight of the structure, while still preventing any objectionable surface deformation that might be conducive to vibrations.

Experimental Equipment

Installation of the radio equipment, together with bonding and ignition shielding, on the Bureau of Standards' airplane, has been completed. It is now possible with this airplane to observe the operation of the visual radio directive beacon system under practical flight conditions, and to carry out many other important lines of investigation concerning the development of radio safety devices for aircraft. Test flights have fully confirmed the expectation of officials of the Bureau of Standards that this laboratory plane would prove extremely helpful.

Warpable two spar surface.



Commander de Pinedo's Savoia Marchetti flying boat Santa Maria on the water at Chicago.

A Sailor Writes of Airways

By John T. Rowland,
Lieutenant, U. S. N. R. F.

GLANCING down the long and tragic record of attempted overseas flights, one is inclined to feel that it would be easier to take a seasoned skipper off a Gloucester schooner and teach him to fly than to instill seasense into the average flyer. This is not surprising, for, like all landsmen, your flyer who does not know the sea distrusts and fears it. In his dealings with it he chooses to copy those small land birds which fly desperately from shore to shore in their long overseas migrations, instead of being like the gull which is equally at home in the air or on the surface of the sea. Yet, if trans-Atlantic air-lines are ever established it will have to be done by the gull type of men and planes rather than by the swallows and the larks.

The reason for this is obvious. No machine propelled by internal combustion motors can be relied upon *always* to go two thousand miles without a stop. And when your land plane is forced down into the ocean it is lost. The same is almost equally true of our so-called seaplanes unless conditions are favorable and, here is the point, unless they are handled by men whose lifelong training has made them at home on the sea. Furthermore, the landsman's whole approach to the problem is false. He conceives of the ocean as a hazard which must be crossed at one "hop," and this leads him so to overload his ship with fuel that flying at all is a risk. I propose to show that this is all unnecessary. There is no reason why planes cannot be designed and built and handled so as to be quite at home on the surface—as much so, at any rate, as the small powerboats which are constantly going to sea—and there is no reason why such a craft should not refuel as often as may be desirable on a cross-seas passage. I have stressed the fuel situation as one productive of great danger. Next to it in degree is the formation of ice on fuselage and wings, which has the same effect, namely, that of compelling the aircraft to come down. Under the right conditions ice builds up with such astonishing rapidity that a plane may be

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forced down before dry air can be reached. To a land plane this is fatal. It is not much better for the average seaplane landing in a rough sea. But with a plane designed to do this very thing when necessary, and capable of remaining indefinitely on the surface the deadly peril of "icing-up" melts quite away.

No matter how skillful a sailor may be he can do little with a vessel that is cranky. I once made a voyage to the Arctic in such a craft. She was thirty feet long and designed by an amateur according to his own ideas. It was a battle the whole way to make her go where we wanted, and we were lucky to get back alive. Similarly, any sailor who looks at a sea-plane of the average type, with her stability dependent upon a set of pontoons or floats, sees at a glance that as a boat she is basically unsound. Since our thesis calls for a ship that will be equally at home on sea or in the air it is necessary to inquire into the requirements of such a design and see how far they are capable of being harmonized. When that is done we shall turn to the question of seamanship—the actual handling of such a craft on the surface of the open sea.

If it were possible to build a boat according to accepted principles and make an airship of her by the mere addition of propeller and wings the thing would doubtless have been done long ago. While that unfortunately is not practical it is nevertheless true that the concept of a "flying boat" followed by our Navy in its big bombers and other sea-planes is a guide-post along the right road. It means a concentration of weights within a buoyant hull which is capable of behaving as a boat should do in the midst of waves. And right here let me say that waves are what constitute the whole problem; on perfectly smooth water there is none, and the pontoon type of landing gear works quite well. The trouble, however, with even the "flying boat" type of seaplane is that when it lands on the water its supporting plane (or as a sailor would say, its center of buoyancy) shifts downward several feet from the under surface of the wings to the waterline of the hull, or thereabouts. This means that the ship which has had stability in the air is top-heavy on the water. It tends to flop over on one side and put the wing-tip in the water. To counteract this and hold the "boat" upright, designers have placed small floats or pontoons under the tips of the wings. These serve their purpose, to be sure, but they also violate one of the cardinal principles in the design of all craft intended to go to sea, which is that there must be nothing for the waves to catch hold of outside the hull itself. Anyone who has tried rowing even a small skiff in a choppy sea and has had a wave-top grasp one of his oars and wrench it out of his hold, perhaps knocking him over backwards into the bottom of the boat, has some slight idea of the destructive force waves can exert. It is a tribute to the wonderful structural strength of our present sea-planes that their wings are not torn off by the first sea over which they ride. This may occur if the sea becomes bad, and indeed it has happened more than once. To a sailor's mind it rules out the airplane with pontoons from any serious consideration as a seagoing craft.

The need then is to find some way to support the ship and hold its wings at all times clear of the waves without resorting to any other agency than the hull itself. This is made more difficult by the fact that one of the principal weights, the motor, must be placed relatively high in order to keep the propeller blades from striking the water. It would take a very wide hull indeed to keep such a "boat" on an even keel—so wide that it would either be too heavy for the wings to lift or else so lightly built that in all probability it would pound to pieces.

If, however, we were to remove entirely the middle portion (fore and aft) of our very wide hull there would result a considerable saving in weight with very little loss of righting moment. Besides which, each of the two separate hulls so formed might be far better molded to withstand the stresses of wave and wind. This seems, therefore, the best solution from a seagoing point of view: a monoplane with a double or catamaran hull, having the motor elevated between the two halves. True, the catamaran is not a perfect sea boat but it is far preferable to a hull with outrigger pontoons, and what it sacrifices in structural strength it more than makes up for in stability. Moreover, it has already been given a pretty severe try-out in at least one case and proven well suited to the job. This was the great air voyage of Commander de Pinedo of the Italian Navy, when he flew a Savoia-55 double-hulled flying boat over 17,000 miles of sea and land before she was destroyed by fire through the carelessness of an onlooker while refuelling on Roosevelt Lake, Arizona. This ship the Commander describes as a "double-boat monoplane, powered by two Isotta Fraschini engines of the Asso 500-horsepower type. Its fuel capacity is 4,000 litres (1,056 gallons) and it attains minimum gas and oil economy at 100 miles per hour." (The word minimum is evidently an error in translation.) Twice during his two crossings of the Atlantic Ocean de Pinedo was forced down under adverse conditions, the first time owing to shortage of fuel. Although it was blowing a gale and a wicked sea was running he not only landed successfully but refueled from a Brazilian cruiser and proceeded on his way. His only danger appeared to be when awkward seamanship threatened to wreck his craft against the cruiser's steel hull.

Assuming that some adaptation of the principle just outlined will give us a seaworthy ship, let us turn to the problems involved in handling her as such.

To launch a boat of any kind in a rough sea requires long experience and very great skill. If this is true of lowering a lifeboat from the davits of a motionless steamer how much more so is it of landing a plane on the surface at high speed. Yet anyone who has seen a fishing skipper run his hundred-foot schooner alongside a dory in a gale of wind, hook her on to the tackles and hoist her in over the lee rail without so much as scraping her side, will appreciate what a tremendous factor experience is in dealing with ships or boats of any sort. For instance, no one can lay down rules about the behavior of waves at sea, yet every sailor knows that they follow certain laws and have certain peculiarities which he is able to recognize and even within limits to predict. Some of these phenomena, such as the "smooth" which follows two or three excessively high waves, might be of the greatest importance in landing a plane. One needs to know, too, that the advancing front of a wave is steeper than the back slope, that waves are more confused and irregular and therefore more dangerous in the neighborhood of land and in regions traversed by ocean currents such as the Gulf Stream than they are in the deep sea, and that a wave crest is always steepest just as it commences to break.

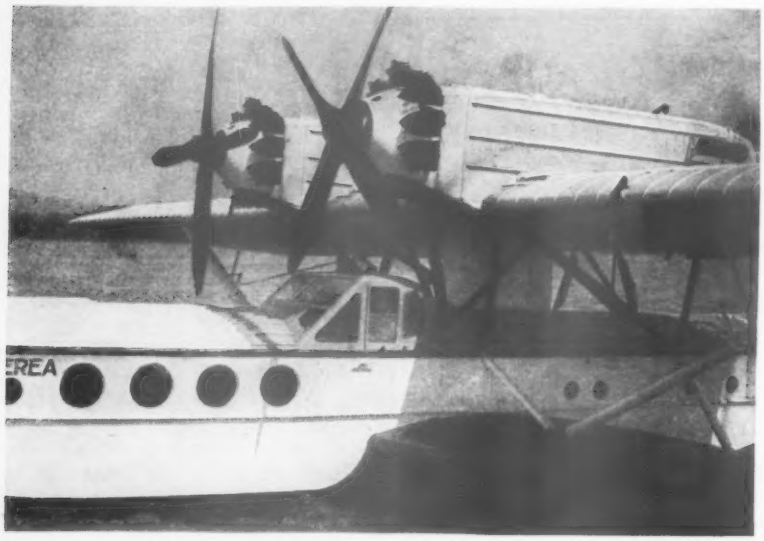
"I have read over the article written by your friend, Mr. Rowland, and I think that it is really a marvelous exposition of the possibilities of cross-seas flight.

"As this article is composed with much nautical and aeronautical competence, while I compliment Mr. Rowland on his study, I believe there are no suggestions or corrections that could be made on it.

"I am, with my best regards,
"Sincerely yours,
(Signed) "F. de Pinedo"

Such things are elementary; every man accustomed to handling vessels makes use of these and a thousand kindred facts without stopping to think; yet I venture to believe that to the majority of land-trained flyers they are entirely unknown. And the point is that it is not enough merely to know about such things; one must have that almost intuitive adaptation to them which comes only from long experience in their use. Sailormen have this—and sailormen can be taught to fly. That is what I mean by the seagull type of flyer. Such a man, in my opinion, will one day revolutionize the art.

If this is true of landing a plane on the surface it holds good to an even greater extent after she is down, for then she has become a true boat and must be handled as one. There are whole volumes devoted to the management of small craft at sea, and I have no doubt as much will be written eventually about the seaplane, but it is my purpose here only to indicate the nature of the problems to be solved and show that they are problems for the sailor, in which his experience with other types of craft will be of inestimable value.



Commander Rosendahl, U. S. N., of the Los Angeles, acted as guest-pilot on a flight in this Dornier from Lake Constance.

For example, let us suppose that a seaplane has been forced down owing to some defect of machinery, and finds it necessary to ride out a gale before pursuing her course. She is lying motionless and apparently helpless in the trough of the sea. Every foaming crest that rushes down at her threatens to engulf her or to crush her and tear her apart. Does her pilot know that by the use of a drogue or sea-anchor she may be brought to lie head-to-wind and ride over the seas with ease? And that an oil-bag hauled out to the drogue on an endless line rove through a block on the swivel of the drogue will spread a slick to leeward on which she may ride untroubled by rolling crests? Or that the proper way to rig his drogue will be from a bridle between the two hulls, to keep her from yawing about? Such a bridle, made of wire rope with a good becket in the middle, should probably be part of the standing rigging of the plane.

But planes and boats all differ, and what is the proper manoeuvre for one will perhaps be all wrong for another. In the case of a 50-foot powerboat in which I once rode out a gale on the way to Bermuda we discovered at the end of a harrowing night, during which she threatened repeatedly to roll clear over, that she would lie quite comfortably hung up by the tail. We shifted the line of the sea anchor aft and made it fast to the stern bitts, and after that rested in peace. The point is, of course, that experience works wonders. Without experience many a ship is lost that might easily have been saved. Given a seaworthy type of plane, albeit with peculiarities that will have to be learned, there seems no good reason why an experienced seaman-pilot might not bring her to rest on the surface with as much confidence as your Gloucester fisherman heaves his vessel to for the night. If one is troubled by fog or sleet or a gale of head wind and short of gas, he need only come down and lie-to till it is past. Not so glorious perhaps as a non-stop flight, but far more practical and safe. And in one sense it will be a greater triumph, since it will mark the mastery of both air and sea.

Such a pilot would not be worried by the task of taking on fuel at sea. He would get his gas, not from some big steamer that had been sent out at great cost, but from a small fishing schooner such as go to sea from Gloucester and Boston and Halifax every week in the year. And if he could not find his "gas station" in the fog she could be relied upon to find him, provided he came down within a radius of twenty or thirty miles. A small radio direction finder on the schooner would naturally be a great help. In fueling it would not be necessary for the plane actually to approach the schooner's side. She would lie quite comfortably under the schooner's lee at the end of a long seapainter, and take her drink through a hose, just as we used to fuel sub-chasers during the war. And on the schooner would be men who could manage the whole show—and even bring the airplane's crew aboard the vessel for a mug-up while they were waiting. Going off in a dory is all in the day's work to them. Yet instead of this perfectly simple and obvious procedure there are those who actually contemplate building huge floating platforms so that land planes with wheels under them may cross the sea!

The records of the Navy Department show that the picture I have just drawn is no dream. Seaplanes of the NC type have landed on the open ocean in a sixty-mile gale, lain there for an hour or two and then taken off and gone on. This was done, I believe, as a test. It shows what may be accomplished when "boats" even of this not wholly satisfactory type are handled by men who know the sea. And with all respect to these youngsters they are not in the same class with deep-sea fishermen or experienced yachtsmen, where seamanship is concerned.

What it is necessary for us to do in order to build up a really practical flying marine is to train sailormen to handle planes, and then give them what they and not the landsmen engineers consider the best type of plane in which to cross the sea.

Louisiana Aero Clubs

Aerial activity is progressing in Louisiana. One of the very active aero units is the Alexandria Aero Club, which has been sponsored by J. R. Dellmon and associates. Two meetings have been held and over fifty members enrolled in this unit. E. Levy of Alexandria, La., writes of the interest of the city officials and county authorities in establishing an airport for the city of Alexandria.

Clegg J. LaBouve of 310 Weeks Street, New Iberia, La., is actively working to form an Aero Club in his community.

The Flight of the Question Mark

By Maj. H. A. Erickson

Air Corps Reserve

THE army's trimotored Fokker—named the Question Mark because it was going aloft in an endeavor to answer the question of how long its engines would run—was forced down after 150 hours, 40 minutes and 15 seconds because of a very minor trouble.

The nature of the trouble is significant, because the engines demonstrated clearly their ability to run at least 300 hours without stopping. This would be almost sufficient time for the Question Mark or a similar plane to fly around the world.

The Question Mark came down because of worn rocker-arms. Their play had increased from a few thousandths of an inch to over a half-inch. This caused the left engine to go "out of time" and naturally it would not function.

When the flight ended the left engine had quit; the right engine, while functioning, was streaming oil, and the center engine had dropped to 1300 r.p.m. During the final contact the Question Mark lost nearly 1500 ft. altitude, took on the gasoline, in fact, with the left engine dead. Immediately following the contact Staff Sergeant Roy Hooe climbed out on the catwalk in an endeavor to start the engine again. His examination proved it too far gone for repair during flight.

Thirty hours before the flight's end engine trouble threatened to send the plane down. All three engines appeared to be doomed, but the trouble cleared away and the flyers thought then they could remain aloft indefinitely. At one o'clock Jan. 7, the final day, Lieut. Quesada handed the controls to Capt. Eaker and at that moment the left engine quit. With the heavy load it was impossible for two engines to keep the Fokker in the air. The plane lost another 1500 feet while turning to remain within a safe radius of the field. Then Capt. Eaker shut off the right engine and glided toward Metropolitan Airport. Later he said that he had been flying so long he had lost some of his sense of altitude and was ready to land when still 100 feet above the runway.

As the Question Mark reached earth again, she had surpassed the flight of the ill-fated French dirigible Dixmude by 32 hours, had beaten the Graf Zeppelin's west-bound Atlantic flight by 39 hours and 5500 miles, had outdistanced the Risticz-Zimmerman duration flight over Germany by 85 hours and beaten the Belgian refueling record by more than twice the time. The Belgians Crooey and Groenen remained in the air 60 hours, 7 minutes.

Army officials feel particularly elated over the flight inasmuch as it demonstrated that refueling can be accomplished under nearly any conditions, both during day and night, without special preparation other than provision of adequate and properly located tanks in the planes and means of conveying the fuel from one to the other. The Question Mark reached Rockwell field, San Diego, shortly before Christmas. The chief discovery made between that day and January 1 was that oil could not be transferred from the floor tanks in the fuel planes to the Question Mark for two reasons: (1) Being both cold and heavy, it would flow too slowly through the hose. (2) Not being under pressure, it would cease flowing when the operator pulled in the line to compensate for altitude changes between the two planes.

On the night before the flight no substitute plan had been worked out. Then, as later proved typical of the flight, some one suggested that oil be delivered in five-gallon tins hung on the end of a rope. This was attempted, and 50-odd 5-gallon cans were delivered in this manner without mishap. Hot food was delivered in thermo-packs fitted into lined canvas bags; underwear from Mrs. Helen R. Quesada was passed along to Lieut. Quesada, her son; other equipment needed from time to time was similarly delivered. The flyers dined on hot soup, hot chicken and ice cream when their appetites called for such delicacies.

The flying burden fell principally on the shoulders of Capt. Eaker, while Major Spatz assumed the responsibility of handling refueling operations aboard the Question Mark. When the planes reached fueling position, both were throttled down to 70 m.p.h. Major Spatz, once he caught the hose, held it in the funnel. On several occasions he was drenched and once was reported to have been burned by the gasoline and cold air.

Each fuel plane carried a maximum of 250 gallons of gasoline. Since the Question Mark was burning nearly 36 gallons of gasoline an hour, it was necessary to refuel during the night. This gas flowed from two tanks above into the fuselage tank of the Question Mark. From here it was hand-pumped by Sergeant Hooe to wing tanks. The officers occasionally took turns at pumping as it helped keep them awake and warm. It proved too cold for any of them to take a bath during the week, though soap and towels were lowered for that purpose.

It was planned at the outset to have Douglas (C1) fuel planes stationed at

Copy of entries in field book at Metropolitan Airport showing signatures of crew and record of flight.

Make	Plane Model	License	Arrivals—Departures Date	Hour	Owner	Pilot Name	License	Persons Carried Crew	Passengers	Field Attendant's Remarks	Pilots Signatures
Fokker	C 2A	AC 28-120	A 12/30/28	3:06 P.M.	U.S. Army	A Capt. J.C. Eaker		A 5		Breaking All Existing World Records for Sustained Flight by Any Type Aircraft	
			D 1/1/29	7:27 A.M.		D Capt. J.C. Eaker		D 5			
"	"	"	A 1/7/29	2:07 P.M.	"	A Capt. J.C. Eaker		A 5		Autographs of Crew	
			D	M		D		D			
			A	M		A		A		Pilot-Shot Co.	
			D	M		D		D			
			A	M		A		A		Elwood R. Quesada	
			D	M		D		D			
			A	M		A		A		H.H. Halverson	
			D	M		D		D			
			A	M		A		A		Roy W. Hooe St. Sgt.	
			D	M		D		D			
Buick		388	A 1-1-29	8:20 A.M.	Buick	A Wm. D. Whitehead	T417	A 2	3		
			D 1-1-29	7:30 A.M.		D Wm. D. Whitehead	T417	D 2	3	Man	
Golden Eagle	Sport	X98E	12-2-29	6:25 A.M.	Ro. Bone	A Bobbie Trout	P2613	A 1	—	Breaking World's Endurance	
			1-2-29	6:26 P.M.		D Bobbie Trout	"	D 1	—	Records for Women by 4 hrs. 8 min.	
Stearman	Wright Whirlwind	NC 3519	A 1-1-29	7:20 A.M.	Pacific Aeronautics	A W.E.T. Homa 3	T 299	A 1	2	Wright Whirlwind Motor	
			D	M		D		D			

XUM

The Question Mark receiving one of her fuel rations.

Los Angeles, San Diego and Imperial. The latter station was established to provide fueling means if rough weather forced the plane across the mountains. Very early in the flight, however, this plane was moved to Los Angeles where most of the operations were conducted.

The Question Mark took off with a light load. Its ultimate gasoline capacity would keep it in the air less than a day. The fuselage tank had a capacity of 300 gallons. Also in the fuselage were arranged three bunks, two on one side, one above the other, and one on the other side. Oil tanks holding 40 gallons were arranged alongside the gasoline tanks.

Aft of the sleeping quarters is the special refueling compartment where Major Spatz spent much of his time. There is plenty of room in the Question Mark for the crew to move about. The space outside was reserved for Sergeant Hooe, though he went out only once and then just before the flight ended.

The big question mark, crudely painted on the sides of the Fokker, was removed before the flight and in its place were painted two interrogation points in black and gold. Only one other bit of decoration was carried—a painting, on a piece of plywood, in the other compartment. It depicts the world's first refueling flight, that of Lieuts. Smith, Richter, Hine and Seifert over San Diego in 1923.

Just as gasoline trucks are carefully "grounded" to prevent static electricity which might cause an explosion, and the hose of a filling station is similarly taken care of, so were the refueling operations protected. All metal parts in the Fokker and fuel planes were bonded together and a wire ran along the hose with which gasoline was sent down.

The flight was conducted directly under supervision of the War Department and for the announced purpose of keeping the plane in the air as long as its engines would function. "There will be but one objective," said Major Gen. James E. Fechet, chief of the air corps, before the flight, "and that is to refuel the plane when fuel is needed and keep it in the air until the engines cease to hum. While it will be interesting to learn how long airplane engines will continue to run under actual flying conditions and without a landing being made, our primary concern is to determine the practicability of refueling while in the air.

"Preliminary research was made in 1923 when Lieuts. Lowell H. Smith and John P. Richter conducted experiments which had their climax in a border-to-border flight along the Pacific coast in 12 hours, 13 minutes. This flight furnished opportunity for the transfer of 125 gallons of gasoline. Prior to this test the same two pilots remained in the air for almost 24 hours in an ordinary D-H observation plane by means of refueling. Experience gained in these trials will prove of great value in the Question Mark's test."

General Fechet's hopes found fulfillment. In the 1923 flight, only one engine powered each plane, and while in 1923 a total of only 125 gallons of gasoline were transferred, about 5,000 gallons were transferred to the Question Mark in the present flight.

F. Trubee Davison, assistant secretary of war, in whose hands rested plans for the flight and under whose direct supervision it was staged, declared following the flight that it has demonstrated the efficacy of refueling for long-distance uninterrupted flights for large planes, for refueling large military planes when ground areas are not available to land them and for "bigger and better" commercial planes to fly long distances without devoting a large space to fuel. This could be taken on, he pointed out, just as the Question Mark took on gasoline.

It was largely an element of luck that the left engine quit when 150 hours had been passed. Possibly it was one engine in 10,000 whose rocker-arms would have

The message plane ready for a trip into the air.

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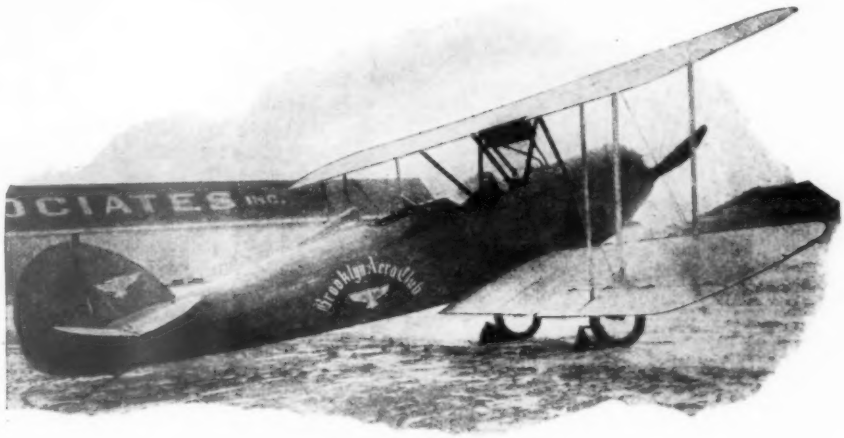

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Between August 13th and December 7th 1928, the Ship's Log shows a record of over 300 hours, all instruction work, including approximately twelve hundred student landings. Many of these landings were the kind that are calculated to break the instructor's heart -- and the landing gear.

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Sincerely yours,
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Instructor

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Major Spatz in the Question Mark establishing contact with refueling plane over the Imperial Valley.

worn as they did. On another flight the engines might continue in operation 300 hours or more with no rocker-arm trouble, or again they might have trouble in another direction. Apparently it continues to be largely a matter of chance.

Some army pilots I know would be willing to leave immediately in the Question Mark on an attempted round-the-world flight. Of course they would want adequate facilities provided at proper intervals for such an endeavor. Within territorial United States they could make use of air mail facilities, and fueling planes could rise from government-used fields already in operation. The width of the United States would be hardly more than one-tenth of the entire journey, however, and facilities would have to be prepared on the oceans and in foreign countries.

Rear Admiral Wm. A. Moffett, chief of the Navy's bureau of aeronautics, declared the flight demonstrates the possibility of a non-stop round-the-world flight. In fact, some think the air corps has in mind just such an attempt. Should this be tried, the plane selected could take on fuel approximately every 1,000 miles across the United States utilizing equipment already existing for the air mail; refuel at Imperial Airways stations now in existence in Europe and as far as Siam at intervals of less than 1,000 miles and take fuel from planes rising from the decks of carriers in the oceans. Special arrangements, Admiral Moffett pointed out, could be made in China, Japan and at other points where no facilities exist.

It was a veteran crew that handled the refueling of the Question Mark. Major Spatz, Capt. Eaker, Lieuts. H. A. Halvorsen and Quesada and Sergeant Hooe flew in the Question Mark. Fuel ship No. 1, operating at first from Rockwell Field and transferred later to Metropolitan Airport, carried Capt. Ross G. Hoyt and Lieuts. I. A. Woodring and A. C. Strickland. Fuel ship No. 2, at first assigned to Imperial and soon transferred to Metropolitan Airport, carried Lieuts. Odas Moon, V. H. Hopkins and R. H. Clark. Lieuts. Arthur Ennis and R. G. Harris and H. J. Adamson, assistants to Secretary Davison at the War Department, had charge of communications, while Adamson maintained contact for the flight with newspapers and press associations.

The Question Mark in its long flight demonstrated that refueling is relatively a simple matter. I had the rare privilege and pleasure of flying in the Question Mark with Major Carl Spatz, flight commander, and his crew during a series of refueling operations immediately prior to the world record flight. My flights took place from the Rockwell Field Army Air Station at North Island, San Diego, California. Since the experiences of that flight duplicated those of the record flight, the story may be interesting.

As soon as the motors were warmed up, Major Spatz called me to climb aboard and I followed Captain Ira C. Eaker and Lt. Elwood R. Quesada and Major Spatz, followed by Sergeant Roy Hooe. Adjusting our parachutes, we all assumed our places with Captain Eaker at the controls and Lt. Quesada also in the pilots' cockpit. Major Spatz and Sergeant Hooe took their places in the rear of the fuselage. In a few minutes we were taking off over North Island. Flying in wide circles, we reached an elevation of 2,000 feet. Then Captain Eaker headed the plane north to the point of contact where we were to meet the refueling transport piloted by Captain White. Within twenty minutes from the time we left the ground the transport hove in sight, and in less than 30 seconds after we sighted it both planes were in position and the first contact was made. This contact was typical of those that

Left to right, Major Spatz, Major Sneed, and Mr. H. J. Adamson, War Department representative.

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followed during the record flight. The crew of the transport lowered a container which was received by Major Spatz who was standing on a stool and ready to take the line from the upper pilot. In shorter time than it takes to tell, the Major had this container and Hooe had handed to Major Spatz the other empty container which was handed back up to the transport. Then the first contact was broken and the Question Mark plane proceeded on.

In another fifteen or twenty minutes the second transport plane came into sight. The crew of the Question Mark immediately prepared to take on the first gasoline. Sergeant Hooe and Major Spatz placed the large funnel in place and Sergeant Hooe adjusted the two four-inch pipes from the funnel to the reserve gas tanks. Major Spatz immediately assumed his position on the stool in the rear of the plane, and Sergeant Hooe stood by to see that the gasoline flowed properly into the tanks. Meanwhile, Captain Eaker was jockeying the huge tri-motored Fokker into position underneath the transport, while Lieutenant Quesada was carrying on signals with the transport so that we could have the exact distance and the exact amount of hose necessary to reach the Question Mark.

With the uproar of the three motors still ringing in their ears, the crew of the Question Mark climb out after more than six days in the air.

As soon as the contact was made Major Spatz signalled to turn the gas on. Lieutenant Quesada flashed the signals on to the men in the transport above and at the next moment the gasoline was running at the rate of ninety gallons a minute into the tanks. In the meantime Captain Eaker was jockeying the ship with his right hand on the throttles and his left hand on the wheel and looking upward, watching every move the transport was making. This contact lasted some six minutes, when 180 gallons of gasoline were sent into the tanks of the Fokker, sufficient for five hours' flying.

In watching Captain Eaker at the controls, in fact, in observing the entire crew during actual contact, one felt that the nervous tension of the men was very noticeable. Every man was alive to the possibilities and the dangers of contact at the close range of 12 to 20 feet and not one of the crew relaxed from their position for one moment. Though everything worked in shipshape style, and was as perfect as could be made possible, the tension of the crew was noticeable throughout. Later, during the long flight, they relaxed and undertook refueling as routine.

Lt. Quesada during the entire contact was holding his right hand up in the forward cockpit signalling to the crew in the plane above, and also keeping an eye out for any signals from Major Spatz in the rear. As soon as sufficient gasoline had been received, Major Spatz signalled to Lt. Quesada, who gave the signals to Captain Eaker and to the transport above to break contact, and the tri-motored plane dropped down out of contact and the fuel transport flew away out of the danger zone.

Seven contacts were made during the two flights, lasting some three and a half hours, during which time oil, water, and wet batteries, as well as gasoline, were transferred from one ship to the other. During this time a message plane came up a number of times with messages from the ground for the information of the crew of the Fokker. These messages were written on the side of the fuselage and were easily readable.

Major Spatz as flight commander had general supervision or command of the flight. He personally received the hose from the transport plane and put the nozzle into the large funnel in the tri-motor. His position was dangerous because he had to hold the nozzle in this funnel and with the ship swinging up and down he frequently got a gasoline spray. It proved a rather ticklish job.

Captain Eaker, chief pilot, one of the most experienced pilots in the service, was at the controls during fueling operations and he seemed to be the least nervous. He was calm and cool, watching everything, seeing everything, and within the fraction of a second able to drop the large plane out of the danger zone during these contacts.

Lt. Quesada, an expert pilot, flew the plane during the night or greater part of it. He is a young chap and assistant pilot to Captain Eaker. Lt. Halverson was an assistant pilot.

Sergeant Hooe had as much to do as anybody in the plane. He is a pilot and an expert mechanic and in case of motor failure or trouble was to go out on the catwalks and report any motor trouble. The greatest danger during refueling is the possibility of coming into bumpy air. This is very dangerous on account of the close proximity of the two planes. During the night the air was smoother.

At one time during the earlier flight Major Spatz crawled forward to say something to Captain Eaker. When he passed me I asked him if everything was okay, and he replied that everything was working excellently and going according to program. During the refueling I attempted to joke with one of the officers, but failed to get a smile out of them. This indicates how great was their tension.

During one of the contacts, Captain Eaker was flying into the sun when the fuel transport came into sight. This made it rather hard for him to see the transport. He finally jockeyed the plane into position and was practically flying straight into the sun. This of course made it difficult to maintain position. Captain Eaker sat with his hands on the controls, looking straight up as a person would look at the ceiling, watching the transport, speeding and retarding his motor and never relaxing a moment.

The pilots of the upper plane disregarded the plane below entirely. They flew a straight level line and the man in

(*Continued on page* 104)

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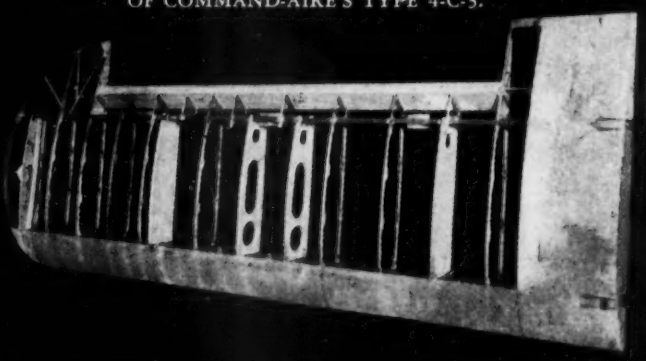

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No. 55

CURRENT COMMENT

Harley W. Mitchell

ONE of the characteristics of the aviation business has been a certain dyed-in-the-wool conservatism. This is to be commended, for there is no business in which mistakes or failures demand such a penalty. But it should be noticed that our English friends, who are generally characterized as the most conservative people in the world, are beginning to say, even publicly, that aviation advance is dependent upon outside influence. The editor of "The Aeroplane," Mr. Grey, pays reluctant tribute to foreign, and particularly German, ideas. He makes some brief but pointed remarks concerning conservatism as applied to aviation.

The Old Die-Hards

It is characteristic of conservatism that it fast becomes reactionary and arrogant. There is developing in this country a reactionary group in aviation that have delegated to themselves the preservation of what they believe to be the "in-all" and "end-all" of aviation. This group resents the intrusion of new men, new capital and new enterprise. In them, and in themselves alone, they believe the safety and the future of this great business lies. Their resentment against new projects is sometimes carried to the point of whispered innuendo, under-cover statements about irresponsibility, and like subtle weapons.

EVERY new manufacturer, whether of planes, engines or accessories, has run against this condition. If you did not "belong," if you were not a member of the lodge in good standing, with all the grips and the passwords and the lingo, you were an interloper of the basest sort. Your product was untrustworthy, and none of the "crowd" hesitated to say so. If you did not have behind you a record of sales to the government at perfectly surprising prices your planes were not airworthy, and could not be.

Remember the Automobile

This attitude is not new; it was a characteristic of the automobile industry at one time. If the reader will try to remember the leaders of the automobile business of some years ago, he will be astonished at the mortality among those who were once at the top. New and vigorous companies fought their way to the top by employing the weapons of imagination and the open mind. The conservatives found they lacked the one great asset that is never to be found on the books of a corporation—the good will of the public, and appreciation of their recognition of the public's wants.

THE mere exercise of the ordinary qualities of good sense and sportsmanship ought to dictate a different attitude. A definite number will take this shoe and find that it pinches. Just a brief reminder might be in place here, that during the past year one new manufacturer, with no especial claims to past brilliant aeronautical achievements or political influence, has obtained a place in the public esteem that is the envy of some of the conservatives. Others can and will do the same. The great names of the past may become "of the past" in earnest.

WE are not advocating a wide open industry, or a condition of uncontrolled freedom to manufacture and fly anything that can get off the ground. There has been no stauncher advocate of reasonable and firmly administered regulation than this magazine. One evidence of our attitude is the appointment of our Advertising Advisory Board.

The Aeronautics Advertising Advisory Board

The purpose of this Advisory Board is to make recommendations with reference to the advertisers who use the columns of this magazine. This board will assist us in keeping our advertising columns clean and clear of the publicity of unworthy firms, whose products do not come up to the standard claimed for them, or to the standards set by either public or private requirements.

This board will function for the benefit of our readers, and we ask the consideration of the great buying public for the work of these men who are making some sacrifice of their time and effort without recompense other than the feeling that they are helping this industry at an important time in its development. So much for our attitude, which is unalterably opposed to exploitation by irresponsible or fly-by-night concerns.

WE are simply making a stand for free and open competition. It is our contention that if aviation is to prosper and advance it must do so with the aid and support of all. Reactionaries make poor leaders. Conservatives make good advisors, but when they delegate leadership to themselves industry suffers. From a strictly numerical standpoint, there are not enough of them to man the aviation business as it exists today.

Why Cramp the Aviation Business?

The money and brains in the business today are in to stay. Illegitimate business never survives; it always manages to commit suicide. If the conservatives, to call them by the kindest name, are animated by anything but the most selfish of motives, let them meet with the others on common ground, and act together in amity. The efforts of all are needed to carry forward the great enterprises now in the making. Petty and personal resentments must be dropped. We cannot afford an internal war at a time when public service is what is most needed.

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Survey of Aeronautical Stocks

By R. D. Small

General Manager, Aviation Financing & Trading

THE most satisfactory evidence of the endorsement of the aeronautical industry by the biggest banking interests in the land is connected with the recent financing of the United Aircraft and Transportation Corporation. The National City Bank of New York, and the National City Company, it is understood, provided upwards of $5,000,000 toward the program of financing this merger. Thus the largest banking institution of the Western hemisphere, and one of the three or four largest banking organizations of all time in the world, puts its seal of approval on the aircraft industry.

This consolidation includes the properties of the Boeing Airplane & Transport Corporation of Seattle, Pratt & Whitney Aircraft Corporation of Hartford, Conn., and Chance Vought Corporation. According to the most recent information, it will own the entire amount of stock of the Pratt & Whitney Corp., Boeing Air Transport, Inc., Chance Vought Corp., and the Boeing Airplane Company, and a little over 70% of the Pacific Air Transport Co.

The Pratt & Whitney Corp., will be acquired by the United Aircraft & Transportation Corp., issuing approximately 2¼ shares of their common stock to the company which controls one-half of the common stock of the Pratt & Whitney viz. Niles-Bement-Pond Company, for each one share of the latter company's common stock. The same method will be used in the acquisition of the common shares of the Chance Vought Corp. Preferred and common of the Boeing Airplane & Transportation will be exchanged on a basis of share for share for the preferred and common of the United Aircraft and Transportation.

Capital structure: 1,000,000 shares, 6% pfd., ($50 par value) authorized, to be presently outstanding 240,000 shares; 2,500,000 shares common stock authorized, to be presently outstanding 1,500,000 shares.

The five companies included in the consolidation will continue with their now existing management for the time being.

Management and Officers: Wm. E. Boeing, Chairman of the Board; Fred B. Rentscheler, President (now president of Pratt & Whitney); Chance Vought, Vice President; Chas. W. Deeds, Sec'y and Treas. (now director of National City Bank). The directorate will also include Phil G. Johnson, President of Boeing Air Transport; Chas. F. Kettering, Vice Pres. of Gen. Motors Corp.; K. R. Kingsbury, Pres. Standard Oil of California; Chas. R. Knickerbocker, Vice President of the Griffin Wheel Company of Chicago; George J. Mead, Vice President and Chief Engineer of the Pratt & Whitney Corp.; G. E. Newberry, Attorney of Los Angeles; W. B. Mayo, Chief Engineer of the Ford Motor Co.; G. S. Rentscheler, Asst. to the President of the National City Bank; J. P. Ripley, Vice Pres. of the National City Bank; O. W. Tupper, Sec'y and Treas. of Boeing Airplane & Transport Corporation.

Market on United Aircraft and Transportation at this writing is 88-89. The shares are listed on the New York Curb.

North American Aviation, Incorporated, was organized under Delaware laws by C. M. Keys, and his associates. Mr. Keys, it is claimed, is popularly said to be "the best connected" member of the "upper ten" of the entire aeronautical family. His chief connections include Presidency of the Curtiss Aeroplane & Motor Company, director of National Aviation Corp., President of Transcontinental Air Transport, director of the National Cash Register Co., Chairman of the executive committee and director of National Air Transport, Chairman of the Board of Curtiss Flying Service and a director in many other aeronautical companies. Vice President, J. Cheever Cowden, is Vice President of Blair & Company, and a director of Transcontinental Air Transport. The executive committee includes the above names, and also Lester Kennedy, director of the National Air Transport; J. B. Smith, Treas. of Curtiss Flying Service; B. A. Tompkins, President of Banker's Company, New York; James C. Wilson, President of National Aviation Corporation.

The Board of Directors are 52, and include men who are prominently known and identified with many of the leading industries in the United States. Robert K. Cassat; Thos. B. Eastland of Bond Goodwin & Tucker; Parmely Herrick; John D. Hertz; Paul Henderson; Thos. Hitchcock; R. R. McCormick, Pres. and Editor of the Chicago Tribune; Wm. B. Mayo, Chief Engineer of the Ford Motor Co.; John J. Mitchell, Director of National Aviation, Douglas Aircraft, and Curtiss Flying Service; Howard E. Coffin; W. S. Bucklin, Pres. of National Shawmut Bank of Boston; E. H. Reynolds, Pres. of National Air Transport, also Pres. of the Peoples Trust & Savings Bank of Chicago; George Rand, Pres. of the Marine Trust Co., Buffalo; E. A. Pierce of the E. A. Pierce & Co., said to be the largest stock brokerage house in the United States; T. Phillips, Pres. of the Phillips Petroleum Co.; G. M. P. Murphy; Herbert G. Swope; J. A. Talbot, Pres. of the Richfield Oil Co.; W. H. Vanderbilt; Elisha Walker, Pres. of Blair & Co., etc.

Capital structure: 6,000,000 shares, no par authorized, outstanding 2,000,000 shares. The company started with $25,000,000 in cash. Stock was offered to the public at $15 a share, and at this writing is quoted at 18⅛. It is traded on the New York Curb.

The purpose of the organization is to hold, buy, sell and trade in securities of aviation companies, both domestic and foreign. The company has almost at once achieved a very wide popularity amongst investors, both large and small, throughout the United States. For a number of days it was a leader on the New York Curb in the amount of shares traded in.

One of the earliest commitments of this organization was represented by the purchase of the Sperry Gyroscope Co., one of the best known instrument manufacturers of the country. It is understood the company has already purchased securities of a number of the sounder and best organized aviation companies with established earning power.

One of its most recent activities marked up an outstanding advantage for the city of Chicago—that of making Chicago the site of one of the three aviation universities in the country. The other two are allotted to New York, and some city on the West coast. Chicago is already the aviation transport center and it now becomes one of the instruction centers. With the development of a number of airports directly connected with the activities of the North American Aviation Company, and also the Curtiss Flying Service (which will establish the curriculum and control the functioning of the university), it promises to offer a larger number of class "A" airports and landing fields than are possessed by any other large city in the country. It thus will offer combined facilities to airplane manufacturers that no other city can offer. It is understood that Chicago was originally passed by as a university site. Several other cities, including Detroit,

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HOTEL STATLER
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December 19,1928.

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General Airplanes Corporation,
Buffalo, New York.

Dear Mr.MacLean Gardner:

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I am glad to see that you are filling the crying need for a really comfortable salon-car-like interior. It brings one to the end of even such a snow storm journey as we had yesterday, fresh and untired.

I was particularly impressed in flying the Aristocrat--my first small cabin plane--to find the ease of handling and good balance of the controls. You have succeeded in giving a very good range of visibility. I was amazed at its load carrying capacity--three people and all their kit; its low landing speed, and its lateral control at low speed.

When I come to Buffalo again I hope you can see your way to permitting me to borrow it again.

Sincerely yours,
Mary Heath

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had been given serious consideration, but the determination of some public spirited and airminded Chicagoans turned the tide in Chicago's favor.

We are informed that Major R. W. Shroeder will be prominently identified with the air flying instruction courses, which will be under way early this spring. Major Shroeder is often spoken of as "the dean of flyers," and is popularly known to almost every man connected with aviation today. The high level on which the instruction will be conducted is disclosed in the words of Major Shroeder: "If, after a thorough course of instruction we decide they (the students) do not come up to our definite scale of standards we shall inform them they cannot fly, and they will not receive certificates. There are some individuals who are so constitutionally built, that they could never learn to balance a plane in the air. They will be required to meet the fixed standard of Curtiss Flying Service before they are brought to the flying field for actual instruction in the air." Full details as to the dormitories, class rooms, instruction personnel, etc., will be given out at an early date. Chicago is proud of its position in this comprehensive plan to increase the safety and comfort in flying, and to supply a much needed lack of adequate schools in this center of activities. It is also proud of the enterprising men who nailed this opportunity to Chicago instead of letting it slip by to another locality.

One of the most constantly recurrent inquiries on the part of airplane manufacturers is: "Tell us where we can assist buyers of our planes to finance their purchases on the installment plan." We are advised the plans have been completed under which this accommodation is now possible. The Commercial Credit Companies of Baltimore with resources said to be in excess of $100,000,000 have already financed the purchase of a number of large planes, on the partial payment basis. One of the officers of this company is credited with the statement: "Researches have demonstrated that aviation has finally reached the point in stability, safety, and transportation necessity, where it can no longer be ignored by conservative insurance and credit companies. Several insurance companies will offer policies as a part of the financing contract, and it is believed it will not be long before most of the insurance companies will follow suit." It was considered a novel idea when the motor industry first received the assistance of commercial credit back in 1912. 1929 marks the date for the development of commercial credit in purchasing airplanes. The general plan involves a down payment of 33⅓% plus the standard finance charges. Insurance rates are, of course, higher for airplanes than for other items financed on the installment basis. Insurance covers fire, theft, winds, crash, public liability, property damage, and passenger hazards. Only planes selling for $10,000 or more are financed on this arrangement. In the case of a plane costing $21,000 a complete insurance coverage approximates $3,750 depending upon the character of the service, record of the pilot, and the type of plane.

Amongst the advances scored in the aeronautical stocks from Dec. 1 to Jan. 23rd are the following: Western Air Express 300 bid—600 bid; Claude Neon Lights, Inc., 287 bid—43½ bid for the new stock when issued (equivalent to 435 for the old); Aviation Corp. of Americas 31 bid—44 bid; Sikorsky 19½-32; Electrical Products Corp. of Colorado 42-53; Wright 255-283; National Air Transport 335-450; Aviation Securities Corporation 23½ (offering price)—31½.

So much attention has been directed to the financial side of aviation in the past few months, that Popular Aviation and Aeronautics will continue to give more space to developments within the industry as viewed from the angle of the investor. This monthly review, treated from the financial standpoint, was the first of its sort to appear in any of the aeronautical magazines, and it will be continued in an enlarged department.

We therefore direct the attention of our readers to the monthly review on another page of this number. The Editor considers that readers will be interested in comparing the opinions of Mr. Small and Mr. Grover. We can assure them that both gentlemen secure their facts from the most reliable sources, and that a close study of the opportunities presented in the aircraft field to the investor will repay the reader.

We have always entertained the notion that the real selector of an automobile was, in most cases, a woman. The motor industry has been subtle enough to recognize that factor by dressing up both the exterior and the interior of the car to suit a woman's taste and requirements. Why should not the same logic apply to the airplane industry? Isn't it reasonable to assume that the particular maker of planes who takes into account that a greater measure of comfort, roominess, and beauty will register its immediate appeal to the woman, will quickly outstrip the manufacturers who do not? The policy of including a woman on the directorate of airplane manufacturing companies might prove a very sensible recognition that in the last analysis woman's demands for what the future plane is to be in the matter of comfort and beauty, must prevail. Woman's selective importance on everything pertaining to life might thus be capitalized at the outset of this new industry.

The writer recently investigated the passengers' cabin and the pilot's quarters of five of the leading 6 to 12 passenger planes manufactured in the United States, where apparentl only a hunchback could walk with any degree of ease, and the visibility afforded both the pilot and passengers left much to be desired. He then stepped into a passenger cabin of a new airplane now under construction where 72 inches of head room was available, so that a man 6 ft. 2 in. could walk and move without stooping, and where complete visibility was afforded the passengers. The quarters were not over-crowded with an excess of chairs, and furthermore the pilot who investigated this particular job remarked that it was the only pilot's quarters that gave full satisfaction as to visibility that he had encountered in the United States. The matter of comfort is second only to the matter of safety in rapidly promoting that overworked word "airmindedness" in this country.

The United States Government's achievement of keeping a tri-motored Fokker plane in the air for 150 hours, thus breaking all records of all time, for either heavier than air or lighter than air, had a four-fold significance. It not only demonstrated the sturdiness and reliability of the motors, and the plane, but also showed that a crew could very satisfactorily stand up under a 6¼ day flight, and suffer no setback either physically or in their morale. Besides the value of this accomplishment for the United States the greater usefulness and effectiveness of air transportation has been demonstrated.

Curtiss-Caproni is the most recent offering in the aeronautical field. It represents a financing to the extent of $4,000,000, and we are advised involves the Curtiss interests in a program for the production of planes constructed after the designs of the Caproni plane made in Italy. The construction, we are informed will follow a very distinct trend that has manifested itself in Europe of placing the engines tandem and above the body. Stock was brought out at 12½, and is now quoted 17½-18½.

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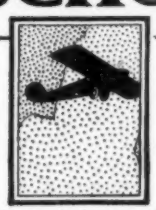

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The Duralumin Propeller

By George Svehla

ONE of the biggest factors in the development of safety in the field of aeronautics is the growing use of the comparatively new duralumin propeller.

Among the advantages possessed by the duralumin propeller are those of: increased performance, greater permissible engine speeds, long life, freedom from affectation by climatic influences, crash resistance, hail and ice resistance, possibility of straightening to true form after bending (Figs. 2 and 3), and certain aero-dynamic properties resulting from sectional thinness.

Fig. 1. A duralumin propeller manufactured by the Standard Steel Propeller Company mounted on a Ford trimotor.

Duralumin is a high strength aluminum forging alloy of the following approximate composition: copper 3.5 to 5.0%, iron 1.25%, silicon 1.25% maximum, manganese 1.25% maximum. Traces of other elements may be found in the different brands of this composition as pigged by the various smelters.

Duralumin, therefore, is a term that can be applied to any aluminum alloy whose composition is such as to be conducive to obtaining a high strength (comparable to that of mild steel) when forged under the proper technique.

Practically all aluminum propeller blades are forged or rolled, although a few experimental blades of an alloy similar to the forging alloy, but less the manganese, were cast for an aeronautic committee.

Up to this time approximately 15,000 duralumin propeller blades have been manufactured by the forging process. The largest part of this number has been turned out by a Pittsburgh manufacturer. Second in point of quantity comes an airplane manufacturer of Milwaukee. This is true despite the fact that a Garden City airplane manufacturer brought out the first practicable duralumin propeller. This propeller was rolled from an aluminum alloy billet and twisted to pitch.

About the same time that this twisted duralumin propeller was brought out, a propeller of light mild steel was being experimented with. In actual trials the blades of mild steel were found to be impractical and further work in that direction was abandoned.

In the spring of 1921 first orders were placed by both the Army and Navy for duralumin propellers. It might be said at this point that practically all the duralumin propellers have been, and are now being, purchased by the Army and Navy.

The procedure in the manufacture of blades for either branch of the government service is as follows: Either branch submits its design of propeller to the manufacturers for bids. On securing a contract the manufacturer places an order with a forge shop for hammered "blanks." To date, practically all the duralumin blades have been forged by a single aluminum forging plant at Cleveland.

At one of these forge plants in the United States the next steps are taken: An ingot of the desired composition is made, and before being released for specified ingot size manufacture is checked for composition and metallurgical requirements.

A metallographic examination of surface defects as well as of weak internal structures has disclosed that segregation of copper is responsible, which fact clearly demonstrates the need of proper control at origin.

A water-cooled ingot is made from the approved smelter ingot. This water-cooled ingot is approximately 8″x8″x 18″x8″x9″.

While the water-cooled ingot is the one most commonly used in making forging billets, billets can also be produced by extrusion. In this process the bar stock is put through the extruding presses which reduce the stock to the desired size. No difference in the mechanical properties of material produced by these two processes has been noticed through a long series of laboratory tests.

The surface of this ingot is then cleaned with an air chisel until all blisters, liquations, and other surface defects are removed.

It is thought that by soaking the ingot for a prolonged time and at a high temperature the forging properties of the metal are improved. The theory of soaking is that the various alloying elements introduced into the aluminum during melting are segregated, and that such soaking drives these elements, especially copper, into "solid solution."

The ingot is then blocked down to approximately 5″x7″x40″ for one-piece propellers, and to a 4½″ diameter for two-piece-propeller blades.

The forging billet is then cropped and fractured to the required length for the particular type of blade being forged. No further operations are usually carried out unless the billet has been approved by the inspector, who ordinarily marks the approved billet by painting.

The next operation is designated as "scalping," which is a milling operation removing approximately ¼″ to ½″ from the surface of the billet and the cutting off of the ragged end. The billet is then either hand forged or hammered to approximate propeller shape on flat dies for two-piece-propeller blades (Figs. 4 and 5) and in a preliminary blocking die for one-piece propellers. The purpose of hammering in the preliminary blocking die is to facilitate manufacturing due to

Fig. 2. A duralumin propeller blade bent as the result of striking the ground.

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BY excellence of instruction, of course, which will bring, in years to come, a fine repute. For that there is no substitute. But what is the answer to the problem in the meantime?

Authorities at the Chicago Aeronautical Exposition estimated an increase from 500% to 800% in the number of flying schools for 1929. The competition to secure students will be keen.

Beauty is a convincing influence upon a man buying a car. Even more, beauty appeals to the flying student. Combine this beauty with sturdy construction and ease of handling as has been done in the MOHAWK "PINTO", and you have the ideal school plane.

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Fig. 3. Propeller blade shown in Figure 2, after being straightened in a die.

difficulties encountered in the handling of the one-piece propeller.

Forging is carried out at a temperature varying from 775° to 825° F. Cold working, that is, forging at a temperature below 525° F., results in a fine grain, but is avoided due to the tendency of the metal to crack during such working. Finishing work, such as on the tip of the propeller blade is, however, carried out at this low temperature.

The procedure with the two-piece propeller will first be discussed in order to keep unity in the narration. In the forging of the blade for the two-piece propeller, the "tong-hold" and hub are formed at the bottom of the original billet. Any excess stock is cut from the fractured end of the billet.

Material of sufficient size from which to cut at least four test bars is then forged from the fractured end. This material is drawn down to approximately 1¾" square and then flattened into a slab about ⅞" thick. To obtain a grain structure in the test material which will correspond to that found in the blade, it is necessary that the material receives the same percentage of forging reduction as the blade received.

The test material is stamped with the number of the blade which it represents. It is then laid out for four or more test bars and sawed, after which the resulting bars are wired together. The test bars, which are turned over to the physical testing laboratory after receiving heat treatment with blades of corresponding numbers, are pulled for tensile strength and elongation before blades of corresponding numbers are trimmed. It is important to remember that the process by which the forging ingot is made will affect the mechanical properties of the metal in the propeller blade.

With ingots obtained under the old water-cooling process, to obtain the best characteristics in a blade, it was necessary to secure a forging reduction of from 50 percent at the hub to 100 percent at the tip of the blade. The greater the forging reduction is, the finer the grain structure obtained, and as a rule the best physical properties accompany the finest grain structure.

To secure this forging reduction in a blade of large size a very large ingot would be necessary, but recent improvements in the method of water cooling ingots has resulted in obtaining fine grain structures in the small size ingots being used.

The rough formed blade is next put in the hub "blocking" die and the hub formed.

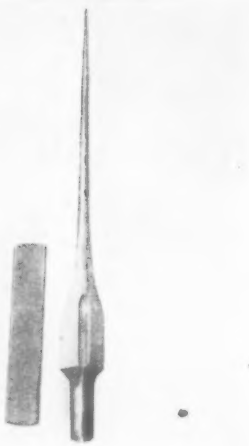


Fig. 4. Edge view of propeller blade, showing tong hold. The blade was made from the billet shown at the left.

Up to the finishing operation, the blades are kept in a preheating furnace until reaching a temperature in the neighborhood of 825° F. The blade is then die forged in a "finishing" die of a heavy drop hammer until it has been forged down to the required size, and is reheated and replaced until reaching the point where it fills out the die.

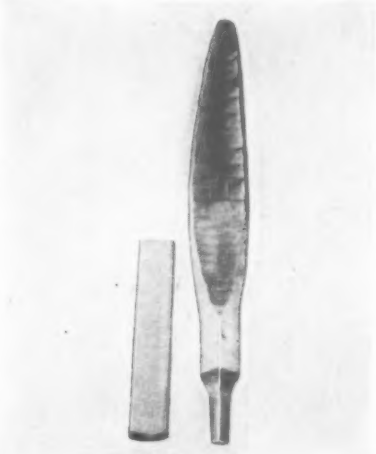
To facilitate metallurgical control, a record is kept of the hammers used, number and temperature of preheating furnaces, temperature of metal, date of forging, and description of forging behavior. The finished blades are then stamped with their numbers, after which they are loaded on racks and delivered to the heat treating department.

On arriving in that department, a record containing detailed information is kept of each "heat" of blades. The heat treatment department also has charge of the hardness testing on both blades and test bars. Government specifications (Army-57-O-A) require that heat treating be done in furnaces under proper pyrometric control. The heat treating department is very careful to see that the temperature of the furnace in which the material is being treated does not exceed the burning temperature. Actual furnace temperature is usually about 30° F. higher than shown on the tapalog of the recording thermometers. It has been found that any temperature above 1020° F. will burn the aluminum alloy. By burning is meant the disruption of the internal structure of the metal and the destruction of its mechanical properties. This itself goes back to the theory of heat treating. By heat treating at a high temperature it is found that a blending of the various elements which go to compose the alloy results in a homogeneous (solid solution) mass.

When blades have been recorded on the above described route sheet they are hung on racks (Fig. 6), the test bars being packed on the same rack (Fig. 7). This method of racking propeller blades is employed so that no propeller blade will bear the weight of another. At the high temperatures employed in heat treating, if a blade was to touch any object with any considerable pressure an impression would be left on the surface of the propeller blade. No blade is heat treated unless accompanied by the test bars of same number. Heat treating is usually done in either steam or electric pit-type furnaces, the time and temperature being about the same as that required for soaking the original ingots.

After receiving heat treatment, the blades are etched by dipping into a caustic soda solution, followed by a wash in clean water, and lastly they are

Fig. 5. Face view of propeller blade shown in Fig. 4. Blade shows preliminary hammering.



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dipped in a nitric acid solution and again washed in fresh water. This results in the metal assuming a fine silvery appearance which permits any surface defects present to become visible to the naked eye.

After etching, the blades are stamped with the heat treatment approval stamp and turned over to the forging department which examines the blades for any visible defects. After receiving the approval of that department, the blades are again stamped with the Inspection O.K. and returned to the forge shop for restriking. This operation is to straighten the blades to true shape, and is made necessary by the warpage resulting from the high temperature employed in heat treating.

After being restruck, the blades are painted on the tonghold to indicate readiness for aging treatment. Test bars also receive aging with the blades.

The purpose of aging is to give an added hardness to the metal. It has

Fig. 6. Method of racking propeller blades for heat treating.

been found that all metals go thru a natural aging, i.e., a hardening period caused by atmospheric conditions. This, however, does not occur to any considerable extent, and requires a long period of time. Artificial aging is that obtained by treating in furnaces at elevated temperatures for extended periods of time. Artificial aging permits the obtaining of a desired hardness in a brief time, and which will be consistent with the properties of tensile strength and elongation. Brinell hardness (BHN) is the standard gauge for hardness determinations of aluminum alloys.

The limits for time and temperature during aging are those at which the results are negligible for the lower limit, while the upper limits are affected by the heat treating temperature and time,

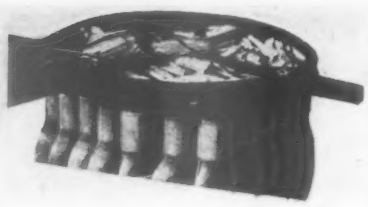


Fig. 7. Method of packing test bars with propeller blades for heat treatment.

and for the best results, the average temperature should be one-third of that required for heat treatment, and the time twice that required for heat treatment.

After aging is completed, a BHN test at the required load (500 k.g. or 1000 k.g. weight, using 10 m.m. impression ball), as specified by that particular branch of the government which contracted for the blades, is made. The BHN impression is usually secured by the use of a Riehle BHN machine, which is either hand operated, or driven by an electric motor for large scale production. Both Army and Navy specify 90 BHN minimum.

If hardness is sufficient the blades are stamped as approved and stacked for government inspection, but if the hardness does not meet specifications, blades are re-aged until arriving at the desired hardness.

To determine the quality of the metal being obtained at the hub end of the blade, the tonghold is knocked off by the forge shop inspectors. This leaves a fracture exposed which will give the desired indication of quality.

On receiving test bars from the heat treating department, the physical test laboratory machines one bar of each

Fig. 9. One-piece propeller at completion of hand forging, showing final length and approximate shape.

number for tensile strength and elongation properties. The diameter of the standard test bar is .505 inches, although smaller diameters are permissible.

Specifications require that all physical tests on government material be witnessed by the government inspector at the contractor's plant, who certifies to their correctness. The contractor furnishes the head resident material inspector with an affidavit certifying to the correctness of the tests, and to the chemical analysis of the "heat" of metal.

If the first test bar "pulled" fails to meet specifications, the remaining test

Fig. 8. Hand forging of one-piece propeller in preliminary stage.

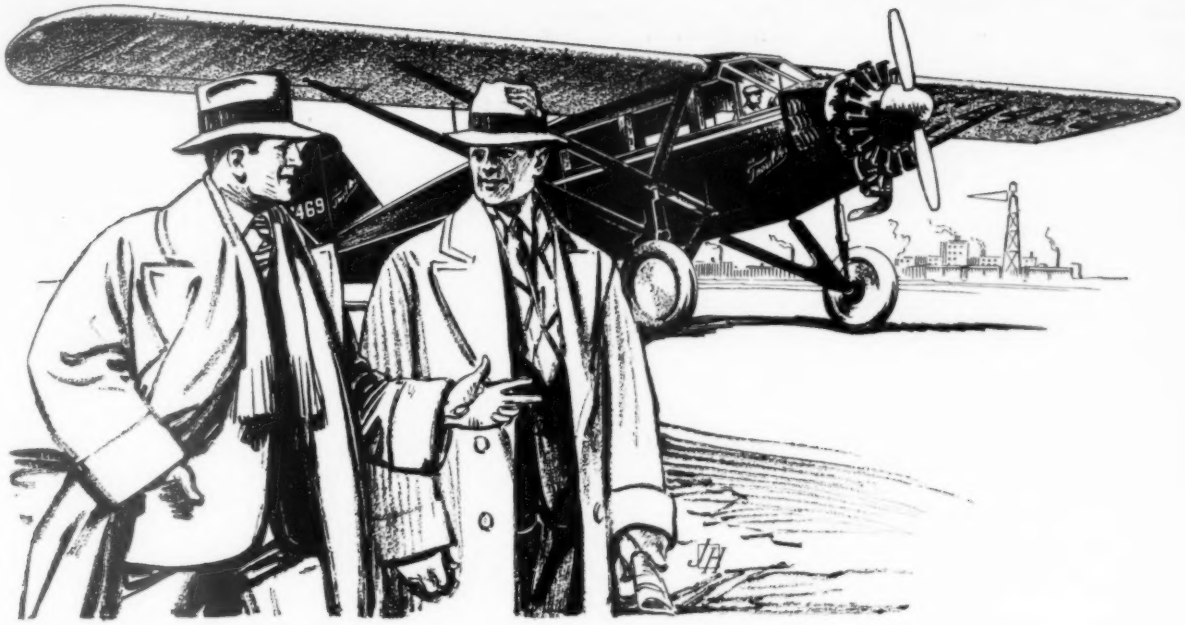
bars are machined and pulled until a passing result is obtained. Government specifications call for a tensile strength of 55,000 lbs. per sq. in., and an elongation of 16.0 percent within gauge limits of 2 inches.

After passing the test bar results, the blade of corresponding number is given a visual examination by the Inspector, who, if he finds it to meet specifications, stamps it with the insignia of the particular branch of the service which he represents. Blades are then packed separately in boxes for shipment to the manufacturer of the finished propeller.

The manufacturer on receiving the blades from the contractor, inspects them for any defects which may have been overlooked.

The blades are then machined and buffed to smooth contour to meet exact specifications for edge and face alignment, hub bolt holes, and section thickness. All steel hubs used for multi-blade propellers are cadmium plated to resist corrosion, and must meet the following specifications for physical properties:

XUM



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Reduction in area.....50.0 percent

After receiving exacting balancing tests, blades are again passed on by government representatives.

Propellers destined for the Army receive a maroon finish, while Navy blades are left bright.

Returning to the method of forging one-piece propellers, the last process described in the manufacture of this type of propeller was that of hammering in the preliminary blocking die.

Due to the size of this type of propeller, forging is not done in the usual flat dies but the propeller is hand forged to approximate shape. (Figs. 8 and 9.)

The tips of the propeller are next fractured. If the first fracture does not disclose a satisfactory appearance, further fractures are taken, until sound metal is reached.

The propeller blank is then forged in the standard die for this type. (Fig. 10.) Forging in the die extends to 30 inches each way of the hub. Following this operation the propeller number is stamped on the hub section. The operation succeeding is that of drawing down the tips of the blank in a tapered die, to the required length of the particular design specified. Following the drawing out of the tips, the propellers receive a heat treatment corresponding to that given to the two-piece propellers; following which they are etched to reveal any surface defects, such as cold shuts, inclusions of dross and foreign material, cracks, laminations, etc.

On passing inspection the forged blank is returned to the hammers for the restrike. Following this operation the final shape of the propeller is laid out by the aid of a templet.

With the templet shape impressed on the blank, the propeller is taken to a band saw and the surplus stock cut off. Test bars are obtained from this surplus stock, and are numbered to correspond with the propeller. Four test bars are taken from each propeller, two of which are sent to the customer with the propeller, which is aged by him according to his own technique.

Propellers are not shipped until the other two test bars have been aged separately and the physical properties obtained. They are then boxed and dispatched to the customer.

On receipt by the customer, the blade is examined, machined, buffed, and balanced. A shaft hole is then drilled in the hub and the propeller tested.

In describing the manufacture of this last type of propeller, the type which is twisted from a rolled slab of the alloy has not been given a prominent place due to the fact that very little information is to be had about the manufacture of this type of propeller. This process, while considerably cheaper than forging, does not give a propeller nearly as strong as the forged article, although it is very much superior to wood or fibre-composite propellers.

The rolled and twisted duralumin propeller may be classed as semi-flexible. It is made of rolled metal ½ of an inch to 1 inch thick, annealed, and cut to the desired shape. The tapering in thickness is begun a short distance from the hub-center and is continued straight to the tips, at which point the thickness is from 1/12 of an inch to ¼ of an inch. The blades are twisted to the proper pitch and heat treated, after which they are drilled to admit the propeller shaft, and then mounted on a specially shaped steel hub.

A big advantage of the duralumin propeller is the thrust created by the profiles

Fig. 10. One-piece propeller after die forging, showing twist given to propeller.

toward the root of the blades. Although small, this contributes to thrust, also producing a cooling blast of air against the nose of the fuselage, which is very useful when a radiator is used at that point. The profiles in this portion of a wood propeller are thick and poorly shaped, serving more in the capacity of strength, and do not create enough thrust to carry even their own weight.

There are very few cases on record where aluminum alloy propellers have been known to fail. Of the known cases, most failures have been due to the tip letting go while the blade was in motion. On examining the blade at point of failure, it has usually been found that the blade contained numerous dents, which when of sufficient depth resulted in a failure from fatigue. A few fractures on examination have been found to be of a crystalline structure, a condition unusual in aluminum alloy. Physical properties obtained in the vicinity of the fractures of the crystalline structure have been found to be good in practically all cases.

While aluminum alloys are being put to new uses daily, especially as concerns the manufacture of aircraft, a metal which has but recently been put on an increased production basis is attracting the attention of engineers. That metal is magnesium together with its alloys. A brief survey of the advances made in its production for aeronautical use follow: Through recent improvement in the refining of magnesium ores found in various European deposits, there is a possibility of its supplementing aluminum alloys for aeronautical uses. Magnesium is the only metal lighter than aluminum possessing commercial possibilities at the present time. It has a specific gravity of 1.74 compared to that of 2.70 for aluminum.

Previous to this time various organizations have attempted to forge magnesium, but have met with little or no success. German aircraft organizations which have pioneered in this work found that their forgings disintegrated on coming in contact with salt water after about one year's service. This has been found to be due to minute quantities of zinc present in magnesium from German deposits.

Late in 1927, a French organization succeeded in making forgings with excellent results, and forgings which successfully withstood corrosion tests. French deposits have been found to be of a superior quality.

This alloy, of an approximate composition of 98.5 percent magnesium, balance copper and iron, has been made into one-piece propellers, which in comparison to the old two-piece wood propeller with steel hub, weighed 32 k.g. against the wood propeller, whose weight was 35 k.g. The English Bristol aircraft engine crankcase has been stamped successfully from this material. The manufacturers have made the entire engine of the alloy except for the connecting rods, valves, and parts subjected to heavy strain and wear.

European manufacturers have also successfully forged pistons from both magnesium and aluminum, in this regard surpassing American manufacturers who still cast pistons by a method which does not give a product that can compare in strength to that produced by forging.

The greatest difficulty which has been encountered in forging magnesium has been the tendency to crack and laminate

(*Continued on page* 97)

Richard Arlen in "Wings", Courtesy Paramount Pictures.

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Sub-Arctic Gasoline Caches

By James Montagnes

FLYING in a Fairchild cabin plane a party of prospectors leave their supply ship on the western shore of Hudson Bay, and pass into the interior of the Barren Lands. On all sides of them are hills, some rising a few hundred feet, others up to a thousand feet, while heavy fog enshrouds the whole. Below is a river. The hills are made of enormous rock formations, polished smooth by the glacial advance of thousands of years before. The roar of the 400 horsepower engine breaks the death-like silence of the countryside, and a few hours later the prospectors land on some unnamed river or lake, take out the food and gasoline supplies that they have brought along, and make camp. The plane leaves them for the ship and another load.

More than a thousand miles to the west a Fokker cabin plane swings along over tree-clad hills and mountains. Gasoline in drums and a few passengers are in the cabin. The plane roars over mountain and valley, with its human and liquid load, to come to anchor on the shores of the Nahanni River in Canada's Northwest Territories, 300 miles from the nearest outpost.

Back 1,500 miles southeast a number of planes are found transporting men and gasoline and food supplies into the interior of Northern Ontario, to various places a few miles or hundreds of miles north of the transcontinental railway line. Amphibians and pontoon-equipped planes are used, and many planes are passed in the air.

What is all this about?

One Canadian mining company, the Northern Aerial Minerals Exploration Limited, founded but a year ago, placed in Canada's northland and sub-Arctic this summer 50,000 gallons of gasoline at $1.25 a gallon and food for two years, in twenty-five different caches spread from the eastern shores of the Hudson Bay to the interior of the Rocky Mountains of the Northwest Territories, covering an area hitherto only accessible by canoe and slow once-a-year schooners which ply up to the Arctic Ocean over inland waterways.

Never before has such a big task been done in the northland in such a short space of time. The best engineers in Canada and the United States, who knew the country to which this vast amount of food and gasoline was going, deemed five years a conservative time to get it in. But with the use of the airplane, together with as many river schooners and supply ships as it was possible to charter, that vast quantity of supplies was brought in and all the men, save a few, were brought out again before freeze-up early in October.

Behind the enterprise is Jack E. Hammel, veteran mining prospector and financier. Three years ago he found the value of the airplane when he flew out in an hour over a trail that it had taken him twelve days to cover some weeks before. Since then he has boosted the airplane for mining.

Assembling a canoe just brought in by plane on the banks of the Nahanni River.

Early in June the schooner "Patrick and Michael" left North Sydney, Nova Scotia, with about 40 prospectors on board, 1,000 drums of gasoline, and enough food and medical supplies to equip half a dozen caches in the Hudson Bay district for two years and several more for shorter periods. About the same time a train left Edmonton, Alberta, for Fort MacMurray, on the Athabasca river in northern Alberta. 750 drums of gasoline and food supplies for more than a dozen caches were carried by the train to the farthest north railway point in the province.

The ship sailed up the coast of Labrador in record time and without mishap passed the Button Islands and so proceeded into the Hudson Straits. On either side loomed forbidding mountains. Here and there ice pans floated down the Straits on their way to the Atlantic Ocean. Now and again a Fokker monoplane was seen overhead, one of the six on patrol by the Canadian government for weather and ice conditions in that district. The good ship "Patrick and Michael" continued on her way and as she neared the junction of the Hudson Bay and the Hudson Straits she changed her course and went southward. Down the east coast with its towering cliffs the ship made its way to Port Harrison where some of the stores and some of the men were landed. Then onward hurriedly the ship went because she had to make a complete circle of the Bay and get out of the Straits before freeze-up. She stopped at Richmond Gulf a little farther down and here two years' supplies were left. Several more stops on the east coast and the ship proceeded down James Bay. Leaving supplies at Moose factory, an important trading post, she sailed up the west side of James Bay and back into the Hudson Bay where she stopped at Churchill, the new terminus of the uncompleted Hudson Bay Railway from Winnipeg. Rushing northward again and making several other stops she reached Chesterfield Inlet, the ultimate goal of the expedition, but not the northernmost. Having unloaded a great quantity of gasoline, food, building material, and two powerful radio transmitters, the ship headed north to Repulse Bay on the Arctic Circle. Here also she left enough supplies for several years and came south again to Chesterfield Inlet.

The radio equipment she left has since been in constant touch with Ottawa, more than 1,500 miles to the southeast.

Up Chesterfield Inlet she tried to make her way but her work was done. She struck a reef. Despite all efforts she could not be dislodged. Now the "Patrick and Michael" is frozen in solid in the sub-Arctic far away from her home port at North Sydney, Nova Scotia.

With the supplies landed at each point it was but a short matter to make the necessary caches and build enough huts to house the few parties of men in the country. At Chesterfield Inlet the airplane came into use for transporting the men and supplies 210 miles farther inland at the top of Baker Lake. Flying

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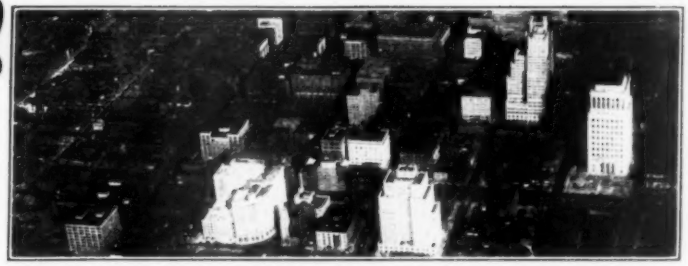

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A Fokker and a Fairchild at a supply base on an unnamed lake in the mountains near the boundary of the Yukon and the Northwest Territories.

a Fairchild against the prevalent north wind which raced along at 40 and 60 miles an hour was most difficult. The course lay east and west following the water route all the way, while hills towered on both sides. On one occasion luck was with the pilot. As he went from Baker Lake east to the Chesterfield Inlet the wind was with him. When he changed his course later on in the day and flew west again the wind also changed its course. The 420 mile trip was made that day in three hours flying time, both times carrying a load of 2,700 pounds.

And on yet another occasion the roaring winds of the district helped the pilot when he made a southward bound trip of fifty miles in fifteen minutes with a full loaded ship. Imagine 200 miles an hour in a country which up to this year has only known the canoe and the dog team as its fastest means of transportation!

To fly by the aid of the compass has become the accustomed thing. But the pilots who flew in the Hudson Bay District this year came back with tales of woe. Chesterfield Inlet is but a scanty 500 miles to the south of the Magnetic Pole. The compasses became useless. Each ship carried two compasses, one regulation instrument and one precision compass, while usually the pilot himself carried a small cheap compass on his coat. Yet even with all these precautions landmarks were the main guide since the compass varied from thirty to fifty degrees in any one place and it was not an unusual thing to have the compass vary fifteen degrees from its true reading after flying one hundred miles.

Meanwhile, the train which had left Edmonton for Fort MacMurray reached its destination, left its cargo, and steamed back to work on more southerly lines. There are only a few boats which sail the inland waterways of the Northwest Territories. The Hudson Bay Company operates them. For the first time during the more than 250 years of its career, the company gave wholehearted assistance to this gigantic private enterprise which was going to open up the mineral wealth of the northwest. Up the Athabasca river to the lake that bears that name the two small schooners made their way. At the lake some of the supplies were left to be flown inland to waterways inaccessible by boat. Now the schooners sailed up the Slave River to Great Slave Lake and here they left their supplies. From here the Fokker plane made daily trips to the Nahanni River, to the Liard River, and to other unnamed lake and river sites which had been picked by the aerial director of the company, Captain Harry A. Oaks, considered one of the best flying men in the Dominion.

The flying captain took load after load of supplies inland. Canoes which could be assembled once they reached their destination were carried. When the prospectors landed at some forest covered mountain side, lake or river shore, they unloaded their food and gasoline and their portable canoes. Had they made the same trips in the old way it would have taken them six weeks to cover the distance they had just come in three hours.

Their path led over mountain and valley, over inaccessible ranges sometimes so rugged in character that landings could not be made over distances of one hundred miles. The pontoon equipped plane flew through heavy fog which often hid the mountain ranges. At other times the weather was clear and the heavily timbered nature of the country stood out in strong comparison with the Barren Lands around Chesterfield Inlet which were equally far north. The growth of heavy timber in that northwest district is stated to be due to the breezes blowing in from the Pacific Ocean, crossing the lower mountain ranges.

Captain Oaks was impressed with the difference in vegetation between this northwest part of Canada next to the Yukon, in which he operated this summer, and the region around Hudson Bay where he also did considerable flying not only this year but in previous years.

"You fly out of Churchill northward bound and soon after leaving the smooth waters of your seaplane base, you see a small clump of trees, perhaps six in number. That is the last stick of timber of any kind that you see north of Churchill," said Captain Oaks.

The operations of the company also included the mining regions in Northern Ontario where hundreds of mines are now in active operation. Beyond the railway, transportation of men and sup-

(*Continued on page* 103)

On the Liard River, Northwest Territories, where a temporary base was constructed.

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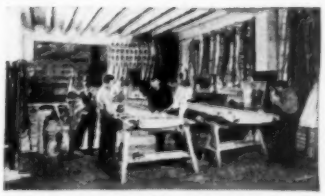

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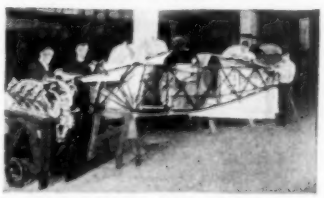

Factory engineer explaining to student construction of engine carrying frame.

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Women students and instructors at Curtiss Field. Margery Brown stands at the left.

What Men Flyers Think of Women Pilots

By Margery Brown

A WELL-KNOWN air-mail pilot, questioned as to what he thought about women going in for aviation, retorted that it wouldn't be printable! Assured that his opinion would be carefully censored before publication, he consented to cite a few of his objections, which, (carefully censored) follow:

Women make poor pilots because (1) they are too emotional, (2) they blow up in a crisis, (3) airplanes are mere playthings to them, (4) their flying is not constructive, since they cannot use it as a business, (5) they usually enter aviation for publicity purposes only.

Another pilot of equal experience, who is also a field manager, replied that ten percent of the women have enough intelligence to learn to fly, and the other ninety percent haven't!

This is a hard indictment. But I have survived severe blows where men flyers' opinions of women flyers are concerned. To be quite honest, I have yet to find a pilot who whole-heartedly endorses the idea of women flying. If one assures you that he approves, beware of taking him at his word; he's only being polite; dig a little deeper and you'll find a sharp resentment or downright opposition.

Women, so a third pilot informed me, don't take flying seriously enough, and they haven't the proper qualifications. They are far too inconsistent.

"If a woman had to make a forced landing," he explained, "she would pick out a field, and immediately change her mind; pick out another, get nearly there; change her mind again, start back to the first—and crack up midway between them!"

He added that due to temperamental tendencies, women make poor automobile drivers, and they will make equally poor pilots for exactly the same reasons.

These arguments are sound. Men flyers aren't nursing a grievance without reason. But it so happens that I am a member of the sex that is under criticism, and having derived incalculable benefit from flying, I am compelled to defend a woman's right to fly.

Yet I see the man's viewpoint, and I agree with him. On the whole, I think he is right. Women are not well fitted by temperament for flying under present conditions.

But, what of it?

Let them change their temperament.

What are some of the objections? (1) Women are too emotional, (2) they blow up in a crisis. Here are two reasons cited. The idea is, that in order to be a good pilot, one must be calm, unemotional, and have control of his mental reactions.

So, the barrier to women becoming good pilots is not the fact of sex at all; it is their apparent lack of the essential

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mental qualities. That ought to be quite clear.

But mental qualities are primarily thoughts, and thoughts are not the exclusive property of the male sex. There is nothing to prevent women from learning to think the thoughts men think about flying. A woman is a free moral agent where thinking itself is concerned. She can have wobbly, inconsistent, indecisive thoughts; or else she can have cool, calm, collected thoughts. The way she thinks determines the way she flies.

If one is content to be a fair-weather flyer, and is satisfied with occasional "field hopping," there is very little risk, that is certain. But who wants to circle around and around a field indefinitely? If one is at all venturesome, forced landings or other difficulties are a possibility, let it be admitted. The question is: how are you, a woman, going to react to trouble?

If you let your equanimity be disturbed when a hat turns out all wrong and makes you look a fright, ten-to-one you'll let that same equanimity be disturbed when a few cylinders begin cutting out! For the truth is, that if you want to be composed and to think clearly when you fly, you will have to cultivate clear thinking and composure under all circumstances. Then it will become a habit with you, and won't desert you in a crisis. You can't very well let yourself boil over with rage because a man (husband or otherwise) breaks an engagement with you, and then go into the air and take it calmly when a motor suddenly breaks its engagement with you.

They say that if one does not get excited, or lose his head, accidents can often be averted; or at least, personal injury can often be averted. But if a woman loses her head half a dozen times a day on the ground, she is bound to lose it frequently in the air.

The time probably will come when flying will require no more ability than automobile driving requires now, but that day is still quite distant. At present flying demands discipline, mental and physical. It is well that women should understand this fact, before they rush into aviation. Women need discipline, even more than men need it. Then, why should men think these moral benefits accrue to themselves alone?

If one were flying in the right spirit and really trying to overcome her faults, by degrees her nature would be transformed, and she would become a different person.

Nothing would do the average woman more good than to spend a few months working in "the shop," which is operated in connection with most flying fields. Here planes are mended, and motors repaired and overhauled.

These men are occupied, they haven't time for the amenities and pleasantries most women expect. If one borrows tools and neglects to return them, her femininity doesn't soften the sharpness of the reprimand. She is told bluntly that if she can't return tools to their proper places, she had better give up working in the shop. When she starts gossiping agreeably with an harrassed mechanic, he curtly says that he is busy, and turns his back.

If her vanity survives it, this is the best possible cure for what ails a woman! She learns to do exactly what the rest of them are doing—pay attention to her job. When she learns to pay strict attention to what she is doing, she will have overcome one of her most obvious faults.

The air mail pilot mentioned at the beginning of this article, who claimed that woman's flying cannot be constructive, certainly was mistaken. It should be remembered that the word "constructive" isn't limited to mere money making. Anything is constructive that teaches a woman to mind her own business.

The contention that most women enter aviation for publicity purposes only would have borne more weight a year ago than today. Newspapers aren't giving women flyers nearly as much publicity as they did, and this is something to be thankful for, because the public has grown weary of persistent harping on the personal note. That sort of thing is dying out.

Many women are thinking of taking up flying—and to these Margery Brown gives a message, telling them what they can expect—and what they will gain from the experience. She is not only "for" flying, but believes that it has a definite value in the life of women who are able to take it up seriously. And—there is something of interest for the men in what she has to say.

His claim that women are too emotional is a sensible objection. This defect is responsible for about three-fourths of their misery, and the sooner they get over it, the better. It is a quality that does nobody any good, and it can be eliminated. The main reason most women are emotional, is because they have nothing better to do. Let them get interested in aviation, and they will quickly become less emotional—or else be forced to give up flying.

I was exceedingly amused one day at a remark made by a pilot who was selling tickets for passenger flights. I said to him, "Aren't women more willing to fly than men?"

"Yes," he replied earnestly, "on Sundays they are; but not on week days."

I laughed heartily at the time, but in thinking it over I discerned what is probably the psychological reason. On Sundays, women are dressed up in their best clothes, are stimulated, looking for excitement, for a thrill, for "something to happen"; hence they are receptive to the suggestion that they fly.

Now, a man would never fly because he was dressed up in his best clothes, and emotionally stimulated. This incident illustrates the fundamental difference between a man and a woman. It is one of the basic reasons for men flyers' objections to women entering aviation. They think women are apt to be too flighty and harum-scarum about flying.

If you are a woman, and are coming to the flying field seeking stimulation, excitement and flattery, you had better stay away until flying is a little bit safer. Where women are concerned, at least, sex and flying are a very poor combination. Sex means vanity, and it is almost impossible to fly safely, if you are thinking of how you look or the impression you are creating. One needs to concentrate all of his attention when flying, and a self-conscious person cannot do that.

If you have visions of yourself cutting capers in the air, and thrilling your admirers, perhaps you had better postpone flying for the time being. If you are planning attractive costumes, and wondering what color most becomes you in a flying coat—again, perhaps you had better postpone flying for a while.

But, if you are thinking that flying will develop character; will teach you to be orderly, well-balanced; will give you an increasingly wider outlook; discipline you, and destroy vanity and pride; enable you to control yourself more and more under all conditions; to think less of yourself and your personal problems, and more of the sublimity and everlasting peace that dwell serene in the heavens . . . if you seek these latter qualities, and think on them exclusively, why—FLY!

It will not matter to you what men flyers think of women pilots.

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C. E. Line, Shop Instructor of the Oceanside-Carlsbad Union High School, Carlsbad, California, has developed a wonderful aero organization among the boys in his school. The club meets every Wednesday at 11:30 A. M. for theoretical instruction. The school is making an effort to secure equipment from the Army and Navy Air Services as other high schools have done throughout the country.

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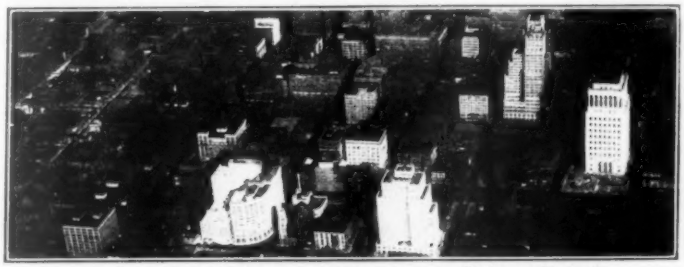

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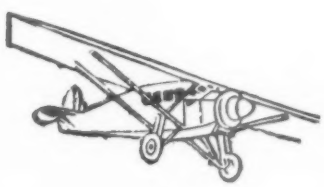

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The $ Sign on the Airplane

By Erle H. Smith

Sales Promotion Manager, American Eagle Aircraft Corporation

IT would be no trick at all to sell an Eskimo a chunk of ice or a Fiji Islander a bottle of Tobasco if they first could be persuaded either could be converted into hard cash.

By the same token, John Jones of Paducah Corners, Wyo., and Elmer E. Dodds, president of the We-X-L Suspender Company, are potential airplane buyers—if first they are sold on the idea of the dollar value of aircraft.

Jones, a youngster with flying ambitions and a diploma from an aviation school, probably will be the easiest to sell. His will be a time payment plan sale. Dodds will have to be sold. His will be a cash payment in full.

The youngster may be in the market for a second plane in two years. Dodds undoubtedly will purchase another machine in a year. He may buy two, one for his business and one for his pleasure. If his first plane is purchased from a company manufacturing a complete line of aircraft, Dodds undoubtedly will purchase his pleasure craft from that builder.

Dodds and Jones represent, figuratively, the United States market. Jones replaces the barnstormer to a large extent. Dodds steps into the shoes of the company in the business or industrial field, which yesterday was using aircraft, gaudily painted and covered with three foot letters, to exploit a new toothpaste or corn cure.

One other field, and that a very large and important one, remains. It is the transportation field. In it can be placed the air mail, aerial express and air liner transportation enterprises. It will be a relatively small field for the builder or the salesman, chiefly because it calls for craft of unusual performance. Mail and express traffic calls for speed and a high safety factor. Transportation calls for multimotored craft capable of lifting and sustaining abnormal loads in flight over long distances.

And so, we must turn back to the two other fields in our search for a realm wherein the mass production builder can expect to operate at a profit to himself and to his clients.

The airplane is going through exactly the same experiences as did the first automobiles but the path is a much straighter and smoother one for having the motor car as a predecessor. People today grasp new things, new ideas, much more rapidly than twenty years ago. They become accustomed to doing new things in new ways almost overnight for such is the speed at which the world is now turning.

More and more we find the airplane becoming the accepted form of transportation. Americans contemplating a tour of Europe inquire just how much of their Continental travel can be made by airplane. Easterners going to Los Angeles find it perfectly natural to include with their original ticket purchase a one way stub by air from the Southern California city to San Francisco. Tomorrow, it will be possible, profitable and readily acceptable to ride by train and plane from coast to coast in almost a third of the time now required by rail. Who can tell, but what next year we may make the journey in a daylight span through the employment of the refueling system.

E. E. Porterfield, Jr., President of the American Eagle Aircraft Corporation of Kansas City.

The airplane ceased to be a flying machine when it began darting through the skies over Flanders Fields and instantly became the world's greatest implement of destruction in wartime. As it emerged from the war, still a crude contraption, it was seized greedily by a world ever looking for an annihilator of space and it became the modern seven league boots which, in less than eight years, has carried man across the Atlantic, over the North Pole, across the Pacific to Australia and created so many astonishing records that the wildest dreamer of wild dreams would fold up his tent and steal away into oblivion.

But, after all, it is the dollar value of the airplane which is going to sell it in the largest numbers. The field of prospects for purely sport or pleasure purposes is quite naturally very small. Selling the right prospects on the dollar value of the airplane today is the biggest problem confronting the manufacturer and distributor of aircraft.

E. E. Porterfield, Jr., president of the American Eagle Aircraft Corporation of Kansas City, believes there is no field which presents greater or more profitable possibilities for the salesman than the merchandising of aircraft. It is not necessarily a field for a super salesman, he points out, but any one familiar with airplanes, their construction, performance and capabilities.

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"Once Jones has his plane, he immediately finds new ways to make it earn dollars. He will operate a taxi service; he will make sightseeing trips, and, very probably, he will launch a school and train other pilots. As they complete their flying and ground school education, they too will become potential purchasers of airplanes. Thus will this field widen.

"Some of these flyers will find their paths directed toward the Doddses. There they will serve as pilots, and if sufficiently alert and progressive, will aid in the development of the many side-

(*Continued on page* 96)

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Sailplane Construction

By Alfried Gymnich

Translated by John H. D. Blanke

(Continued from the January Issue, Installment VI)

THUS far we have dealt with the nature of sailing flight and the constructional make-up of the sailplane, and we have already obtained a general view of the materials. Theoretical discussions have been purposely avoided in order not to discourage the reader at the start and in order to provide him first of all with certain elementary knowledge which is to form the foundation for the theoretical discussions which cannot be avoided later on. Theory and practice must compensate each other, and only when they are taken together do they form a complete intellectual structure.

In consideration of the many inquiries from readers, who would like to start immediately with the building of their own sailplane, the theoretical discussions will, however, be withheld for the present, and we will start at once with the practical building of a schooling or training sailplane. The author realizes clearly that this will perhaps bring with it many difficulties; but just as it is possible to build a radio set which has a complicated circuit, without a theoretical knowledge of electrical science, it is also possible for one to conduct the building of a sailplane upon the basis of exact plans. The prerequisite here, as in other cases, is to observe and follow the building plans and directions accurately. In contrast to radio set construction, strict adherence to the building directions for building a sailplane is indispensable from the outset, because here human lives may be endangered due to insufficient care or unsatisfactory shop work. Besides a good aptitude for interpretation and ability to think in space, a certain skill with tools is an unconditional prerequisite for building a sailplane at home. In order to enter more deeply into the extensive physical principles involved, it is, however, not sufficient to build merely according to a plan, for we must also know why the individual parts of construction have just such and such a shape and dimension. Whenever it appears necessary, we will enter into such individual factors as are of importance for an understanding of the connections in aviatorial engineering.

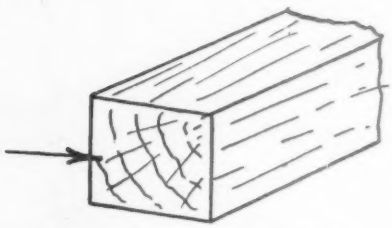


Fig. 1. The arrow indicates the cross-grained surface of the wood, which cannot be glued.

From the beginning it is again emphasized that only the most painstaking care and accuracy can lead to the goal. Even in the carrying out of apparently incidental matters one must always bear in mind that the later flying and operating safety of the machine depends upon the exact execution of all the shop work in every detail. If a piece of work was not produced the first time as it was thought of or as it is indicated in the building instructions, it must simply be done over again. One dare never think: It will work anyway. Whoever starts with such a frivolous idea in building a sailplane is better off if he keeps his hands aloof from it, for through a later crash caused perhaps by his superficiality he only harms the entire sailflying movement, and he will never get anywhere in this field which demands complete mental and physical devotion.

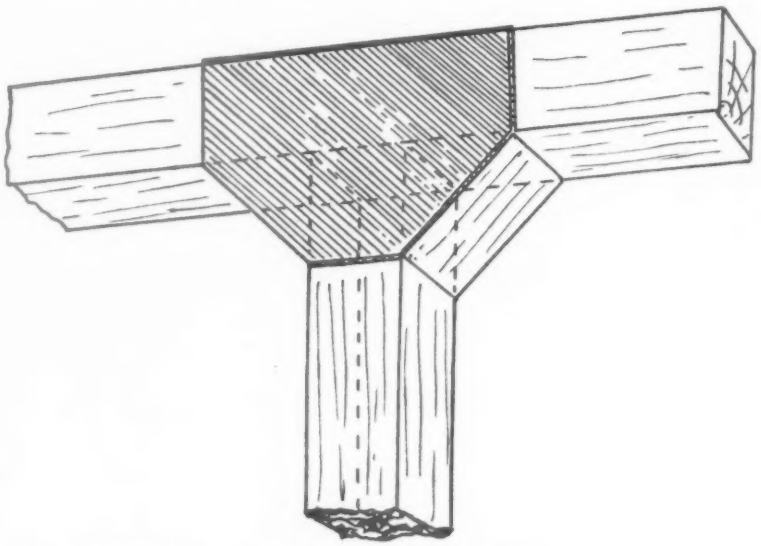


Fig. 2. Corner block connections are made with the joints glued and lapped over with thin plywood.

All parts of our plane, which are intended for taking up and passing along any essential forces, must be made into a framework of triangular connection, for only the triangular connection is rigid in itself and therefore suited for transmitting forces without deforming the parts of construction. Whether the triangular connection be obtained thereby by means of diagonal stays or by means of diagonal braces, is in itself without importance. We are using only diagonal stays for the building of our sailplane, since because of this any special fittings for the attaching of wires are avoided. Careful connection of the junctions is to be considered as the most essential point

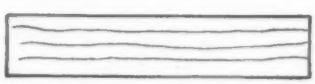
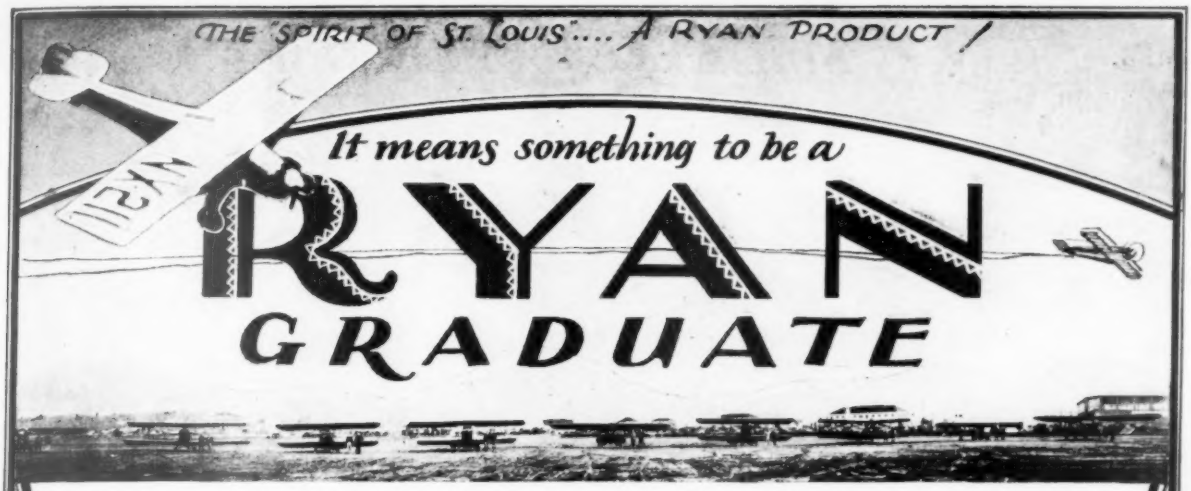


Fig. 3. How the grain of the wood should run (right), and how it should not run (left).



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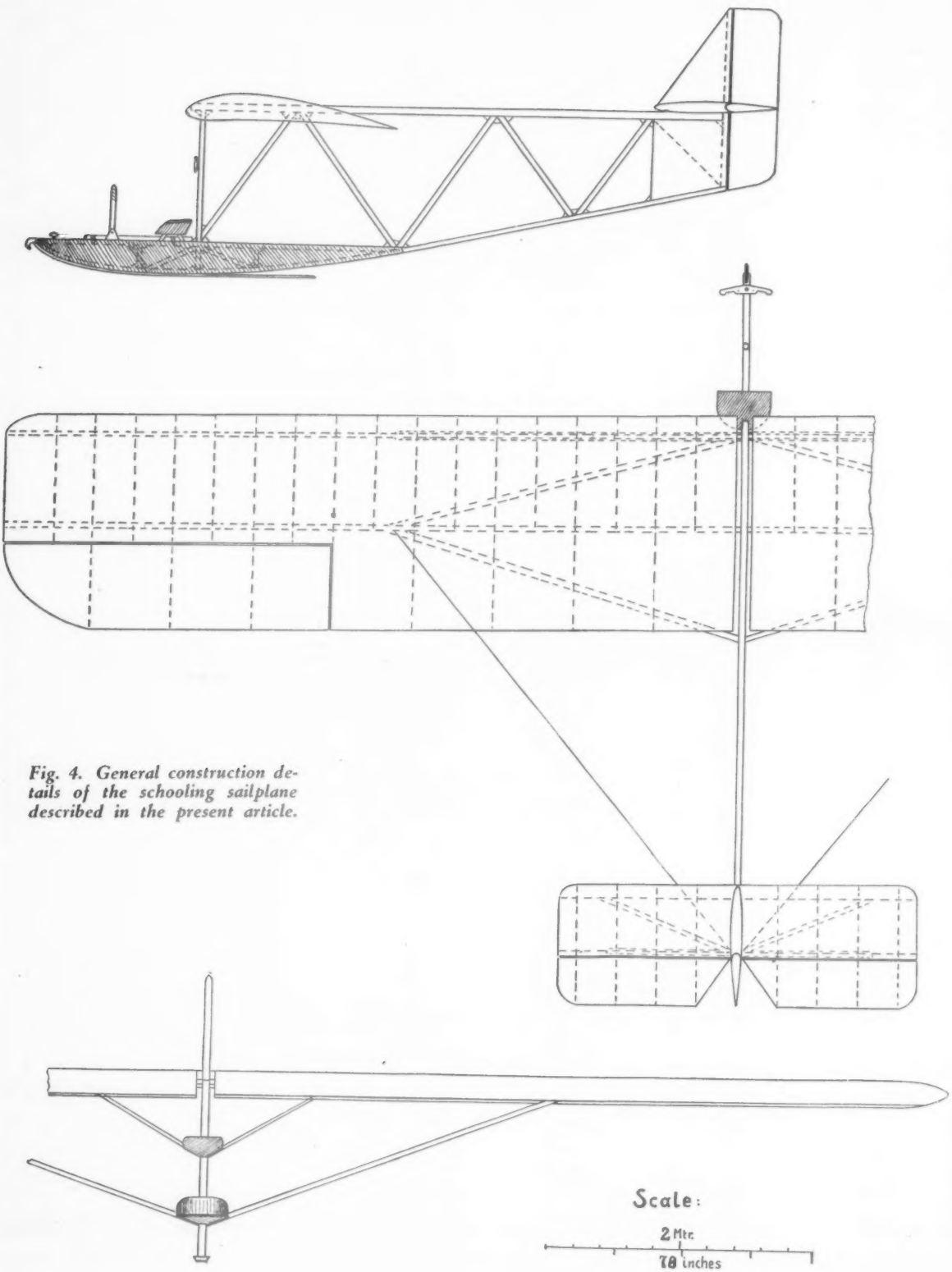
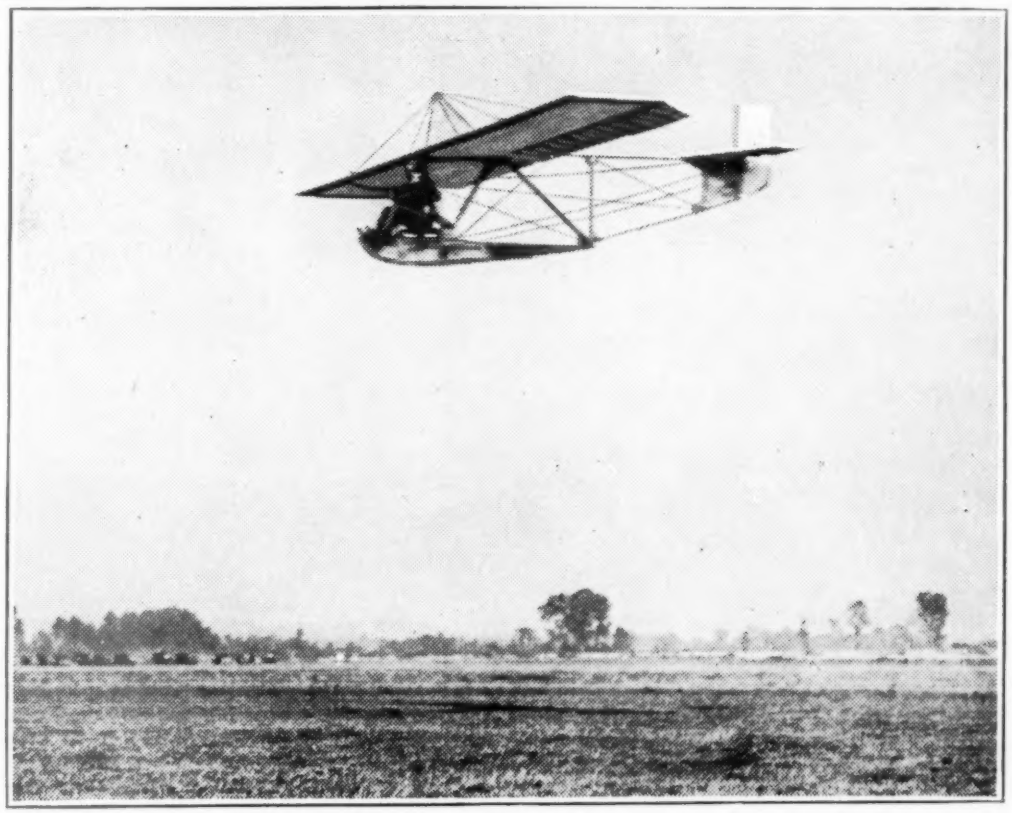


Fig. 4. General construction details of the schooling sailplane described in the present article.

[*Photograph of glider in flight at Minneapolis, Minnesota, Sept. 17th, 1928*]



The blue prints in book form including drawings of the simple fittings needed, complete details of all plane parts and a written set of specifications are available at $3.00 per set.

Gliders will be popular for many reasons. First, they are cheap to build, costing around $125.00; second, men can learn a great deal about flying from glider instruction; third, they can be flown at fifteen miles per hour and can be towed behind automobiles for short distances; in fact, they can even be towed behind aeroplanes, as has been done in Germany. Read the attached special offer.

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in the building of frameworks, such as are represented in the supporting wings and the fuselage frame. All points of junction are made by the glueing in of corner blocks or corner ledges. Another connection of stays touching each other perpendicularly, is possible only by aid of fittings, for glueings of cross-grained wood never hold. By cross-grained wood one understands the cut surface running across or transverse to the direction of the grain. If feasible, the junction points should be plated over with thin plywood. The wood to be used must be entirely air-dry, free of knots and cut in the direction of the grain. Wood screws find no use at all in sailplane building and nails are practical only in the manner of small copper or brass pins for the applying of plywood and for connections of corner blocks to assist in the glueing. In shafting the longitudinal beams, the obliquely running glueing surfaces must be at least ten times longer than the diameter of the beam. The glueing joints must of course always be pressed tightly together by means of screw clamps. After about 12 hours the glue has set sufficiently so that the glued parts can be worked. However, beams or similar important parts should remain at least 24 hours under the clamp pressure. It is of course understood that only cold glue, so-called casein glue, be used, since the ordinary strong glue or joiner's glue is not resistant to water. However, the cold lime, when in prepared condition, loses its adhesive energy after 6 to 8 hours, and one dare never prepare more glue than can be used within this period. Exact directions for use accompany every glue powder.

The shop should be as light and roomy as possible, having at least a floor area of 13 by 20 feet. The door should be large so that one can pass with the built-up parts into the open without trouble. It is desirable for the door of the shop to lead directly into an open space to permit the assembly of the plane for test purposes. In the line of tools one should have, if possible, every tool that is used in a joinery, such as a planing bench, hand saw, turning saw, compass saw, hand drill, vise, a variety of planes, etc.

Naturally it is perhaps seldom the case that all these tools are available or can be secured. Therefore one should, if possible, arrange with a joinery shop, or some similar organization, to make use of a portion of the shop and of the tools. At the same time one gains thereby the possibility of expert counsel for working the wood.

Now, first of all we must consider which type of plane we wish to build. First of all we are interested in financial and constructional considerations, for our schooling plane is to be built at the lowest cost and it is not to exact too great requirements in point of skill and patience. Furthermore, the plane is to be easily assembled and disassembled and permit possibility of easy repair, for minor damages will frequently happen during the first flying attempt of the novice. For all these reasons we will select as the construction type the open seat glider such as has been discussed further back in these articles. The seat glider can be built with relatively small means and it meets all the above requirements. However, in place of the customary bracing of the supporting wings we will use stays, for hereby is eliminated the burdensome tightening of the supporting wings, whose two halves must of course receive exactly the same angle of adjustment; and thereby we facilitate the assembly and disassembly very considerably. The angle of adjustment of the supporting wing is that angle which is formed by the longitudinal axis of the plane and the chord of the wing profile. It must not be confused with the angle of attack which is formed by the path of flight, that is, the direction of movement of the air current as against the wing profile. The angle of adjustment has a constant value, whereas the angle of attack varies according to the path of flight or the direction of movement of the air current.

Mr. Gymnich gives the sail flyer enthusiast the scale drawings of his approved sailplane in this issue. Future numbers of Popular Aviation and Aeronautics will contain the balance of the constructional details.

We have now decided on a definite type and must proceed to determine the proportions and size. Naturally we cannot select merely according to desire a certain span or span width, for the size of the span and therewith also the size of the supporting surface, which results as the product from span and wing depth, must stand in a definite relation to the flying weight. The building weight of our plane we can assume empirically, that is, according to experience, as about 75 kg. or 165 lb. The flying weight results accordingly as the building weight plus the weight of the flyer, which is also assumed to be of 75 kg. or 165 lb., making 150 kg. or 331 lb. In a preceding passage we have already observed that the surface load, the flying weight divided by the area of the supporting wings, is between 8 and 12 kg. per sq. m. or 1.6 and 2.5 lb. per sq. ft. for sailplanes. Since our plane will not be especially speedy due to the additional resistance brought about by the fuselage frame and the flyer seated in the open air current, we will at least aim, by way of a relatively low surface load, towards low falling or sinking speed and thereby gain a favorable gliding angle. Therefore we select a supporting surface area or wing area of 17 sq. m. or 183 sq. ft. and thereby obtain a surface load of 150 ÷ 17 which is 8.8 kg. per sq. m. or 331 ÷ 183 or 1.8 per sq. ft.

Now, this supporting surface of 17 sq. m. or 183 sq. ft. may be obtained in various ways; thus we can have, for example, a wing length or span of 7 m. or 23 ft. and a wing depth or chord of 2.43 m. or 8 ft., or a span of 14 m. or 46 ft. and a chord of 1.21 m. or 4 ft. In the first case the relation of the sides or aspect ratio (span to chord) is not quite 1 : 3, in the second case more than 1 : 11. But this aspect ratio is also partly determinative for the aerodynamical value of the supporting wing, for as we have already seen at the beginning of the section on design, the aerodynamic value of a supporting wing increases considerably with a side relation to about 1 : 10 and above that more slowly. Therefore it appears as though it were of advantage to select a rather large span with a narrow chord; but here another obstacle comes in our path. Unfortunately the construction weight of a supporting wing does not merely increase proportionally to the span, but increases rapidly over the span, so that the advantage of a favorable aspect ratio can easily be destroyed again through an excessive building weight. This considerable increase in unit building weight (weight per sq. m. or sq. ft.) is easily explainable, for with an increase in span the leverage arm under which the air-forces attack the supporting wings, increases of course also, and consequently we must figure on larger cross sections of the material of the beams, etc., so that the unit building weight increases. In view of these facts we must arrive at a compromise between the aerodynamic and constructive viewpoints, and since for us the considerations of building must first of all be decisive, we select for ourselves a span of 11 m. or 36 ft. and a wing depth of 1.6 m. or 5 ft., and obtain accordingly a side relation of not quite 1 : 7, which represents a good average value for our conditions. With these dimensions we obtain, of course, 17.6 sq. m. or 189 sq. ft. supporting surface, but since on account of the rounding off of the wing tips we do not have a wing depth of 1.6 m. or 5 ft. for the entire span width, we can figure with roughly 17 sq. m. or 183 sq. ft. We will not enter into detail here concerning those other elements of our machine, whose size and shape are determined by aerodynamic, static and construction considerations; these conditions will be

(*Continued on page* 96)

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"The field for airport engineers is practically unlimited," said Maj. P. G. Kemp, Vice-President of the Universal Aviation Corporation, Chicago, in discussing the future of the Robertson School. "Every city, town, and village, must needs have an airport. Growth of transportation has been directly connected with the development of cities. No city in the history of the world, nor nation, has become great that has not had as the basic underlying cause of its development availability to transportation, either by overland routes, or harbors and rivers, utilized by the cheapest as well as the slowest form of transportation.

"This is true of Venice, Carthage, Paris, Petrograd, Buenos Aires, New York, Chicago at the base of Lake Michigan, and New Orleans at the mouth of the Mississippi. While mountains and rivers will lose their importance, as they will not affect the new form of transportation, the communities already in existence whose success is based on geographical advantages as outlined above, will have to keep step with the new form of transportation or lose their advantages which have accrued to them in the past, on the older and slower means of transportation of a few years ago."

Not only will the cities and villages paint their names along the highways entering the town, but an increasing number have already become apostles to the creed of Will Rogers, and have painted in flaming letters the name of their community on roofs of outstanding buildings, stores, and barns. The next step in each of these communities will be the building of an up-to-the-minute airport. The call for airport engineers is being heard throughout the United States. Engineers with specific training are needed now to design and put into operation thousands of airports.

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The development of airports will go hand in hand with the establishment of passenger lines, which will form a complete network over the entire country, and which at present have reached astounding proportions.

Business men, tourists, and travelers during the coming season will do well to heed the remarks of Mr. Kemp. "The American goes to European countries and comes back with a great deal of enthusiasm for air transportation. It is well understood that except for the German lines, the American tourists make up over 50% of the passengers on European lines. They generally bewail the fact that we are so far behind Europe in air transport—which is not the case.

"All European nations have air transportation available, having made this possible through some form of subsidy, which is against American principles and is really basically unnecessary. Large distances to be covered and a comparative high value set on time by the average American business man, together with the wealth of our citizens, make air transportation in this country able to assess the high tariff necessary to meet expenses without the need of government assistance."

The full value of the airport can not be enhanced by the development of aviation without the development of air transport lines. Local flying alone will not develop and make airports known.

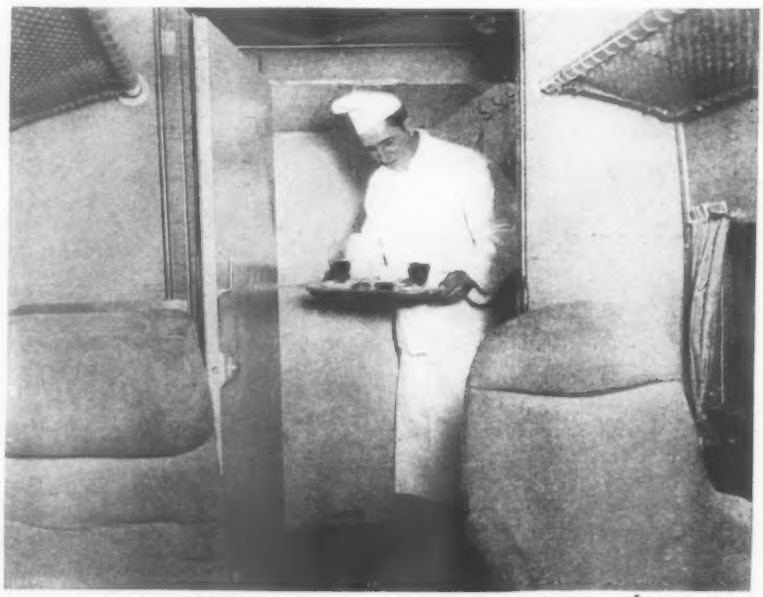
A small group of Chicago men originated and fostered the idea that service by air between New York and Chicago, which would be practically over-night in its effect, thus permitting business men to leave either point at the close of the business day and arrive at their destination at the opening of the following business day, was practical and would prove immensely popular. The Universal Air Lines, Incorporated, was formed so that planes leaving Chicago in the afternoon would connect with the night train from Cleveland arriving in New York the following morning. Passengers leaving New York on the night train, connect with the air transport leaving Cleveland early in the morning and arrive in Chicago less than two hours later.

Groups in Minneapolis and St. Louis, becoming air-minded, wanted to connect their cities with this service and the Universal Air Lines, Incorporated, became the father of the Universal Air Lines System, composed of separate operating companies. Northern Air Lines, Incorporated, operate between Minneapolis and Rochester, Minnesota, Chicago, and Cleveland. The Robertson Air Lines fly between Chicago and St. Louis, and between St. Louis and Kansas City. They also operate the Robertson Flying Service, Incorporated. All of these operating companies comprising the System are owned by the Universal Aviation Corporation.

The year 1929 will see a great enlargement in the available passenger service. The character of the service offered will improve much more rapidly than the number of miles flown. American manufacturers are developing faster, more commodious and luxurious aircraft, with more reliable motors. There is the keen-

(*Continued on page* 94)

Buffet luncheon being served on the Universal Sky Diner, a Fokker Super-Trimotor F-10.



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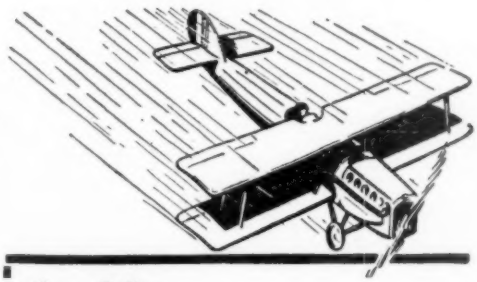

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GROUND FLOOR WORK TO THE SKYS LIMIT !

A Forced Landing in Sunny California

By C. Eugene Johnson

This Forced Landing story won the $100.00 Longines Chronograph that is awarded every month for the best story of a forced landing. The only condition is that the story be submitted by the pilot, or passenger, making the forced landing. Photographs help, as you see by looking over Mr. Johnson's story.

OVER the Sierras, on the San Francisco-Reno run of the Transcontinental Air Mail, one is favored with a view of nature's grandeur that is unsurpassed. A possible exception may be the sight which meets the eye when one peers over the side of a cockpit from an altitude of about 5,000 feet directly above San Francisco Bay region after dark when the atmosphere is totally clear. This latter situation is not as usual as the uninitiated seem to believe, the famous San Francisco fogs ("unusual weather") most generally preventing this indescribable view.

The Sierras, with their deeply cut canyons and crevasses and when heavily mantled with the winter snows, truly present an awe-inspiring sight from the vantage point of an airplane seat, providing the person gazing has no comprehensive knowledge of the temperamental characteristics upon occasions of internal combustion engines. For a distance of about 80 miles through the mountain district, this particular leg of the Transcontinental offers no landing facilities whatsoever. There is not a single spot where one could even crack up with the assurance that the inconveniences would be few and the damage slight. Very soon the U. S. Department of Commerce will have in operation several fields through this district which have practically been hewn out of solid rock and whittled from pine forests. This will take some of the kick out of this run for the old timers.

Mail DH No. 424, now resting her bones in the high Sierras, near Summit, California, left on her eastbound trip on the morning of Feb. 5th, 1927, with an unfavorable weather forecast for the trip to Reno. The Sacramento Valley had its usual blanket of tulle fog, which caused no anxiety because of a fortunate break at Sacramento where the first stop is made. Dayton Baker, concerned as usual about the welfare of the men who flew through his station, passed out the latest data on the Sierra weather, with a pertinent comment or two about it being disgustingly sticky ahead.

The low clouds and light rain mingled with the fog before the foothills were reached, about ten miles to the east. Reno had reported the top of the storm clouds as being about 20,000 feet which eliminated the possibility of going over the top of the mess. The railroad, which winds in and out about twenty miles north of the course, seemed to indicate the only possibile route for getting through under the storm. As the altitude increased the drizzling rain soon turned to snow, gradually getting heavier as No. 424 twisted and turned, following the tracks eastward.

It was not long until the atmosphere was opaque because of the densely falling snow, which blended perfectly with the snow-covered ground, making visibility ahead obscure except for the black ribbons of railroad tracks which were by that time the sole remaining guide for direction and approximate location. The frequent passing of the tracks through the countless snowsheds, heavily covered by many feet of snow, blotted out momentarily what vision there was and offered innumerable anxious moments, with the pilot fervently hoping the ribbons of black steel would emerge at the estimated point. By this time the wings of the ship were but a few feet above the right-of-way and the DH reputation of being a highly maneuverable piece of flying machinery was being well tested.

The Summit pass, about 7,800 feet elevation, was the goal sought, because immediately after a sharp "S" turn through the cut, one could descend almost 1,000 feet as fast as the construction of the ship would permit, and strike fairly level going through the floor of the Truckee Valley for the balance of the trip. When within but a few minutes of the Pass, winter stopped meddling around and down it came. No. 424 then saw the type of weather often reported by the observer at the Summit: "obscurity complete."

A few blind, ineffectual stabs at finding the pass in the swirling mass, with hidden mountains rising dangerously close on all sides, made one realize that there were many places much more restful to the nerves. The high winds and severe downdrafts now prevailing made sharp turns quite interesting. By this time it had become impossible to see the ground in front of the entering edge of the lower wing. Vision of the ground was only to be had by looking straight down off the trailing edge of the wing. Many times tall pines, jutting rocks, etc., brushed by underneath the ship, too close for comfort, and a forced return to Sacramento was quite in order.

In attempting to go back it was found that the storm had increased in intensity in that direction. Despite

The author, C. Eugene Johnson.

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The morning after. The cockpit is against the tree.

the utmost vigilance, it had "closed in to the rear." It had been impossible in the eastward trip to keep a constant watch to the rear to see if this dreaded thing would happen, because the frequent sharp turns blotted out anything more than a quarter mile or so away. Due to the high mountains, hidden from sight, towering several thousand feet above on all sides, it was foolhardy to attempt a "blind" climb up through the thick mass,—a crash into them would have been inevitable.

Realizing the ultimate outcome if the return to Sacramento was prevented, many attempts were made of course to break through and save the much-loved ship, but with no success. Pocketed! Constant circling was then necessary to keep watch on one or two dark objects in the floor of the canyon and to remember just about where those invisible mountain walls ought to be. The visibility in the pocket gradually reduced as the storm thickened. This necessitated dropping lower and lower to keep in view those dark objects below, which now were found to be parts of a river, the life-saving dark spots turning out to be the few portions of the water not bridged over with deep snow.

The flying altitude was now much below the level of the railroad tracks with the canyon narrowing in width as the altitude was decreased. This made it necessary to keep in the tightest possible spiral to prevent collision with the surrounding wall. By then the bottom wing was just missing huge, jagged rocks and tall pines. The ship's proximity to these objects would have caused no anxiety under normal conditions, but the obstacles were not seen on this occasion until after the bottom wing had passed by them, with the ship in a constant vertical bank.

Seventy-two years of this, or as time is reckoned, ten or fifteen minutes, and then,—just one more circle hoping to catch a glimpse of an open and level spot large enough to park the wreck. But Lady Luck was not riding in the mailpit upon that occasion. So with a prayer that the beautiful ship would not be cracked beyond repair, the switches were cut and the gasoline pressure released. A little rudder and aileron to bring the ship out of the bank, easing back on the stick to cut the forward speed to a minimum, and an arm crooked in front of the face, waiting for the crash.

Immense pine trees were mowed down in the path of the ship as cleanly as if some huge knife had severed them. Fifteen to twenty feet of snow on the ground no doubt cushioned the smash, but it needed no careful survey to ascertain that No. 424 had flown her last trip and was a complete washout, and that there was no possibility of ever salvaging as much as a nut or bolt, though the mail was intact.

At last the snowshoes and rations, carried for so many years by all the pilots on this leg, were to be of some use. A fresh snowfall of four feet in the preceding twenty four hours together with the huge storm in progress, made it fairly tough going for the novice on webs. Many hours of steep climbing without the aid of a Liberty-12 finally brought the railroad into view. And a few miles down the railroad a telephone call was made to relieve the anxiety of those concerned.

Having heard a plane constantly milling around in the storm, and realizing that it had landed afterwards somewhere in the vicinity, the wonderfully co-operative Southern Pacific Lines despatched many searchers in that area, though the wreckage was not found until the storm had abated the following day. It was learned also by telephone that the S. P. had despatched a special train to pick up the pilot and bring him to the next division point. The ultimate had been achieved,—a private and special train. In a few minutes it hove into view around the bend in the darkened snowsheds. It was engine and caboose!

Where Mail DH No. 424 rests quietly in the high Sierras.

Glider Club of Wisconsin

One of the most interesting aero clubs to be formed recently is the Glider Club of Wisconsin. The founders are J. P. Schroeter, Arthur Baumann, Clarence Berg, and Paul Schroeter, Jr.

The club plans to give its members a thorough knowledge of glider construction and operation. A monthly lecture is to be given on gliding and the building of gliders. General club meetings are to be held regularly in the Milwaukee Journal Building while a workshop is being rented for constructing club gliders and sail planes. Present plans call for the workshop being open every evening under the supervision of one of the experienced builders. The matter of a suitable flying field has not yet been settled.

Aerial Navigation for the Novice

By Commander Douglas G. Jeffrey
D.S.O., R.N.R., F.R.G.S.

NAVIGATION or the "act of driving a ship across the sea" dates back to the time of Abraham. Shipping laws were promulgated by King Hammurabi of Chaldea some four thousand years ago and Herodotus records a voyage around Africa five hundred years before Christ. The ship as we know it today is the result of very gradual evolution and navigation has advanced step by step with the ship. It is a far cry from Hammurabi to Lindbergh and Byrd, or from the Ark to the "Graf Zeppelin," and the progress of aerial navigation has been crowded for time in its attempt to achieve in a few short and somewhat fevered years what Marine Navigation took forty centuries to accomplish. Aircraft have to some extent outstripped the navigators and despite the efforts of pioneers like Commander Byrd and Lieutenant Commander Weems, the airman's knowledge and interest concerning this side of the profession has not kept pace with other developments. The airman, and he exists, who has no knowledge of navigation is like the seaman who can handle a ship, who can berth her, take her in and out of dock, handle her in traffic, in fact "make her talk," but who has not the ability to take his ship from one port to another with safety and accuracy under all conditions or to fix his position en route. He may be a good seaman but he is no navigator. To get anywhere seamanship must be combined with navigation and in the same way airmanship, however expert, must be supplemented by "Avigation," to borrow a term coined by Lieutenant-Commander Weems.

I am not attempting in these articles, however, to instruct the experienced airman, but merely hope to present in as simple manner as possible some of the elementary and fundamental principles of navigation for the benefit of the "layman" and for those who are as yet "fledglings" in aviation. To get back to the Ark, the earliest seamen were merely coasters sailing from one point of land to another and perhaps occasionally using a star to steer by. It is possible that the Ark had a navigating officer, although we have no record of any officer of the Chaldean Navy being charged by a Court Martial that he did by negligence or default hazard His Majesty's Ship "Ark."

By my side as I write is a modern aviation textbook that devotes one brief chapter to navigation and except for a passing reference to radio, the methods described do not get much beyond those employed four thousand years ago. The story of a certain ship's officer—a "wartime product"—could apply with equal truth to some of our flyers today. On the arrival off a foreign port, the ship was boarded by the local pilot, who after passing the time of day with the Master and turning over the latest newspapers (a time honored custom of pilots) turned to the officer of the watch and said, "I should like an azimuth if you can get one." The O. O. W. looked somewhat at a loss but replied, "I'll do my best with the steward, but it isn't so easy since prohibition, unless you have a 'prescription.'"

Aerial navigation presents difficulties unknown to the sailor, the introduction of the third (vertical) dimension and the inability, in the case of heavier than air craft at least, to "stop, look and listen" in the way that a sea going vessel can being two of the most important. In addition there is the high speed at which air craft travel and the high velocity of air currents. Whereas the Gulf Stream, probably the swiftest of ocean currents, sometimes attains a speed of 5 to 6 miles per hour, fifty miles an hour and upwards is not uncommon in the air. These conditions make the ability to fix his position with speed and accuracy of the utmost importance to the aviator. In the future, not tomorrow perhaps, we shall realize Jules Verne's dream of the Clipper of the Clouds, helicopters, and all the rest, or perhaps go further and produce a ship similar to that described in a book that I read as a youngster, The Log of the Flying Fish. This craft "out Verned" Jules Verne and combined the attributes of the modern airship and submarine. The development of a vessel of this type would certainly settle the battleships vs. planes argument of which we hear so much, but navigation would be more complicated and vital than ever.

As commercial flying develops and competition becomes keener a thorough knowledge of navigation and meteorology will become essential to successful operation. The helicopter is not much beyond the experimental stage; the gyrocompass though admirably suited to marine needs appears to be too heavy and susceptible to vibration, etc., for general aviation purposes; radio beacons are not as yet scattered broadcast over the country, and even with all three perfected, and they will do much to simplify aerial voyages, there will still be fog, bad weather, radio failures, abnormal air currents and the demand for speed and more speed that will make navigation and nautical astronomy as applied to aviation of ever increasing importance.

Nathaniel Bowditch, one of the fathers of modern navigation, gave the fol-

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lowing definition of the science and it can hardly be improved upon: "The science generally termed navigation .... affords the knowledge necessary to conduct a ship from point to point on the earth, enabling the mariner to determine with a sufficient degree of accuracy, the position of his vessel at any time." We have only to substitute "airman" for "marine" and we have all that is required for aerial navigation. Bowditch again divides navigation into two main heads, namely, navigation and nautical astronomy. Navigation in this limited sense is the determination of a ship's position by reference to the earth of fixed objects on the earth and can be subdivided into (a) Dead reckoning which is estimating the position by distance indicated by log and course steered by compass from some well determined point, and (b) Pilotage, in which a ship's position is obtained from bearings of visible objects on the earth, soundings of the depth of the sea, and in modern times radio bearings, etc. Adapting this division to aerial needs we get the following:

AERIAL NAVIGATION

NAVIGATION
Pilotage
Obtaining plane's position by bearings of fixed objects on the earth and by radio beacons, etc.

Commander Douglas G. Jeffrey.

Dead Reckoning
Estimating plane's position by air speed, and course from a well determined position.

Aerial Astronomy
Determining plane's position by aid of celestial objects.

It is proposed to use the above nomenclature throughout this series of articles. A good many nautical phrases will be bound to creep in from time to time, and I trust that the landsman and airman unacquainted with things marine will excuse them, for after all there is a close relationship between the two navigations and also to a far greater extent than is generally realized between airmanship and seamanship. It has been noted that the navy trained youngster, especially if he sails a boat well, will, if he takes to flying, acquire more easily than others the "feel" of the plane that is indispensable to good airmanship. Following the above plan dead reckoning will serve as an introduction to aerial navigation. Dead reckoning in marine circles is frequently referred to as "position by account," indicating that it is at best an estimate and not a determination of position as in the case of bearings of fixed objects on the earth or astronomical observations. In computing dead reckoning, we deal with the following factors: (a) a definitely defined point of departure, (b) the course to be steered, i.e., true bearing of the point it is desired to make, (c) the air speed, and (d) the drift. The following instruments are required: compass, airspeed indicator, drift meter, chart or map, dividers and a ruler

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and protractor or parallel ruler and protractor combined. The Douglas Protractor is a combination instrument of this latter kind, a handy transparent affair that has often been used by the writer.

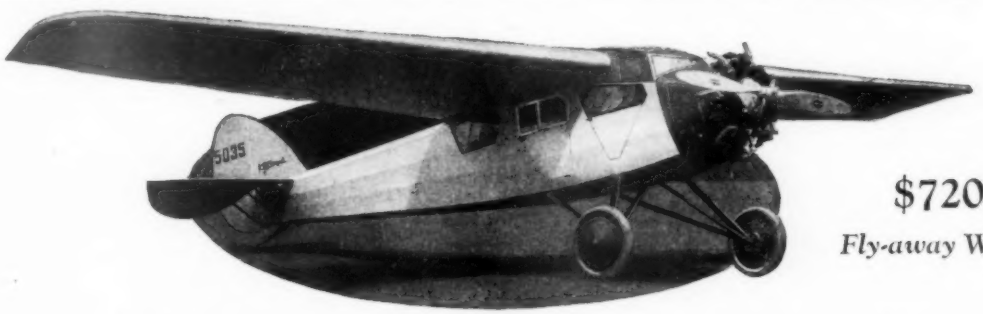
In the present article the magnetic compass will be the only one considered. It is assumed that the general principles of the magnetic compass are understood by everyone and hence no detailed description will be given. The compass card as used in aircraft (see Fig. 1) is either of the flat disc type or thin annular ring type, the latter being the most popular. These cards are marked with the cardinal points and also with degrees. Most navigators have adopted the 0 to 360 system; starting with zero at North the card is divided into 360° so that East becomes 90°, South 180°, and West 270°. The budding navigator will hear courses and bearings quoted in (a) points, e.g., South East, North East by East; in (b) degrees expressed in quadrants, e.g., S. 45° E., N. 56 E., and so on; and (c) in degrees from 0° to 360° as described above. Since all three systems are in use, the capacity to make quick mental conversion from one to the other is essential.

Fig. 1. Pioneer magnetic compass with new Titterington micrometer compensator. The two screws in the base operate a soft iron shield to allow practical compensation.

Compass error is composed of variation and deviation. Variation is the difference between true and magnetic north and varies with time and location. Charts are available showing the variation in various parts of the world and also the annual changes in different locations. The navigator must make sure that the variation used is correct, not only as to place but also as to time. Variation is sometimes referred to as declination, and I have noticed this nomenclature in various aviation text books.

Variation is considered the best term for navigational purposes, inasmuch as declination is a term employed for an entirely different non-magnetic factor used in nautical and aerial astronomy. Deviation arises from the effect exerted on the compass by magnetic metal in the plane itself. It differs in amount and direction according to the direction in which the plane is heading and also undergoes some modification with big changes in locality.

Most pilots can apply errors but I have met many who were incapable of adjusting compasses or even unable to "swing ship" to determine errors. I read somewhere in a recent aviation handbook that it was advisable to check compasses up every month or so. The standing orders of practically every ship sailing the seas contain the instruction to



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the officer of the watch to determine the error of the compass as often as possible, and this is good practice whether afloat or aloft. This precaution is especially important when planes are engaged in service that requires night or bad weather flying. Swinging ship, i.e., adjusting compasses, is not a very complicated operation. The plane is placed in flying position "tail up" and then swung so that its longitudinal axis or fore and aft line lies along each of the cardinal points in turn. Compass bearings of a fixed object whose correct magnetic bearing is known are then taken for each cardinal point, the difference between the observed and magnetic bearing of the object being the deviation. These errors if large (exceeding 5°) are compensated by means of small compensating magnetic needles. In practice it is extremely difficult to get a compass correct on all points but deviation can usually be brought within reasonable limits.

If the effect of an error whether due to variation or deviation is to draw the north end of the compass needle to the right or eastward the error is named east and marked +. If the effect of the error is to draw the north end of the needle to the left or westward the error

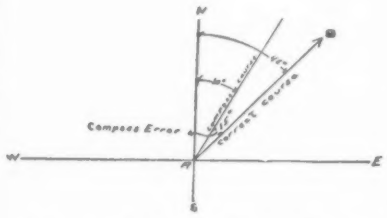

Fig. 2. Correction from true to compass course, i. e., application of deviation and variation.

is named west and marked —. In considering compass errors it is essential to imagine yourself standing in the center of the compass looking out in the direction of the course or bearing to be corrected (See Fig. 2). In calculating aerial dead reckoning we have no "leeway" as

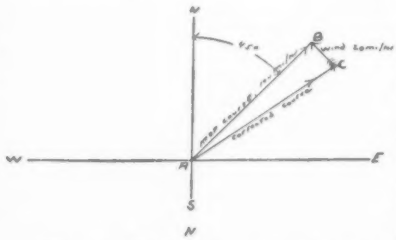

Fig. 3. Correction to true map course for drift.

in marine dead reckoning. "Leeway" refers to the distance that a ship is blown sideways through the water by the force of wind on her hull. Although both ship and plane are supported by the element in which they operate the plane is completely immersed and resembles in this respect the submarine while diving, whereas the surface ship although supported by the water is not immersed and offers a large surface to the effect of the wind. A plane never moves sideways through the air. If the air moves the

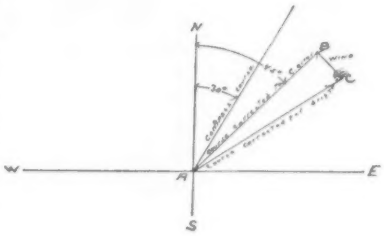

Fig. 4. Correction to true map course for variation and deviation, i. e., total compass error and drift.

plane moves with it describing a path with reference to the earth different from the direction in which it is heading. This fact, simple though it appears, is often misunderstood by the novice.

There are three kinds of courses or bearings (a) true, whose north is toward the geographical North Pole, (b) magnetic, that shown by a compass depending on the earth's lines of magnetic force and whose north is toward the magnetic North Pole and (c) compass, shown by individual compasses in each plane and differing from the magnetic course of bearing by the amount of the deviation caused by the plane's own magnetism deflecting the needle.

A plane wishes to fly from a Point A to a Point B (Fig. 3). The course can be obtained by drawing a straight line from A to B and with a parallel ruler or protractor ascertaining the angle that this line makes with the meridian (true north). This is the true course from A to B, in this case N. 45 E. or to be more modern, 45°. The variation at the point of departure is known to be 11 East and the deviation 4 East giving a total error of 15 East. If deviation is larger than variation and of different name subtract variation from it and vice-versa. We are in this case assuming that there is no change in variation between A and B. In many parts of the world the lines of variation converge and changes are rapid. For instance, be-

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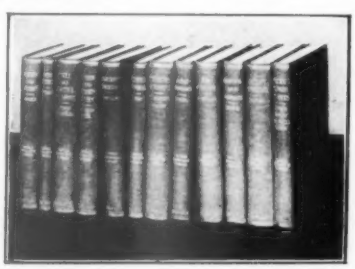

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tween Halifax and New York there is a change of 11°. Conditions of this kind call for frequent changes of courses to conform with the change of variation. In actual practice interpolation is resorted to and a mean variation for a fixed period of time according to the speed of the plane is applied to the course. In the case before us we have a total error of 15 East, i.e., to the right of North, so that if we steered N. 45° E. by our compass we should in reality be making N. 60 E. and would miss "B" altogether. By applying our error of 15° East (+) we steer N. 30° E. N. compass which corresponds to the required N. 45° E. This applying of compass errors is often confusing to the beginner and Bowditch gives a general rule that holds and which avoids the necessity of reasoning out each individual case. This is the rule: "When the correct direction is to the right the error is east." The words correct-right-east thus become a key to all problems of applying compass error. With easterly error we know that to obtain a true course from a compass course the error must be applied to the

(*Continued on page* 106)

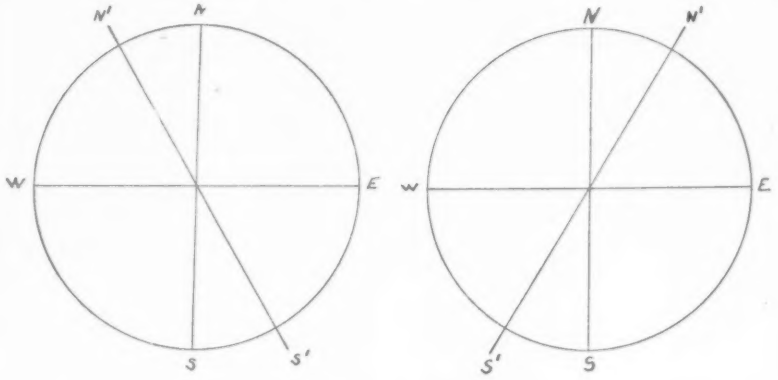

Fig. 5. Compass error. Left westerly error, right easterly error.

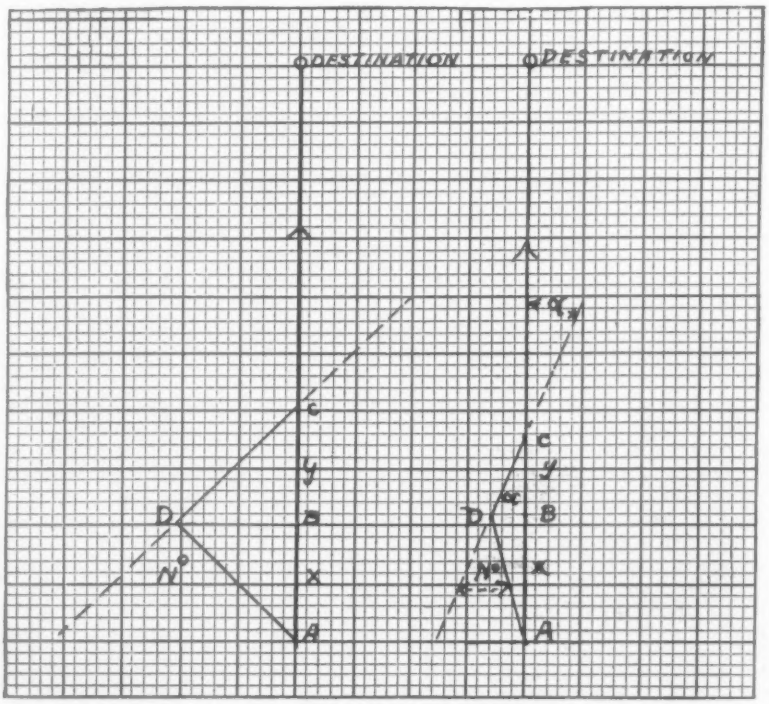

Fig. 6. Point to point navigation showing correction for drift.

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Financial Review

By J. Allen Grover

Pynchon & Co., New York City

THE month before POPULAR AVIATION AND AERONAUTICS went to press has been comparatively quiet in aviation financial circles. After some of the giant mergers which took place in the autumn the Street has found this inactivity refreshing, but there are rumors of much new financing to come.

The end of 1928, which was an amazing year in American financial history, calls to mind inevitably the enormous gains made by various securities. Below is a graphic picture of this activity in the leading aeronautical issues listed on the two main New York exchanges.

	1928		1929
COMPANY	HIGH	LOW	CURRENT
†Curtiss Aero.	192¾	53⅛	158
†Wright	289¾	69	273½
*Aviation Corporation of the Americas	36⅞	27⅜	41¼
*Boeing Air & Transport Co.	97¼	55	87¾
*Curtiss Aeroplane Export	44	19½	32
*Curtiss Flying Service	24	14⅞	23
*Douglas Aircraft	27½	18	28½
*Fairchild	29⅞	21¾	26
*Fokker	23½	16¾	23⅛
*Keystone	57	20	45
*Niles-Bement-Pond	214⅞	28	199
*Transcontinental Air Transport	35	17⅜	26¾
*Universal Aviation	21¼	16½	23

†New York Stock Exchange.
*New York Curb Market.

1929, however, has not been without some of the usual wide advances in the prices of aviation issues. The most spectacular perhaps has been the rise in Warner Aircraft common. Originally issued at 20, it sold under 100 at the beginning of the year, and on January 15 was quoted 190 bid, 200 asked. It is reported that this company contemplates a production of over 1,000 motors in 1929, and the industry as a whole has shown great confidence in its product. Other issues of aeronautical companies traded in "over the counter," including those of investment trusts which specialize in aviation stocks, registered good gains in the last two weeks of trading before this journal went to press. The opening of the Pan American Air Lines was signalized by heavy buying of the common stock of the Aviation Corporation of the Americas on the curb. There is no indication that public interest in aviation stocks has receded. So much for a glimpse of the market.

It was not so very long ago that a banker could not be persuaded to touch an aviation issue, but now the various markets all over the country tell a very different story. The industry as a whole unquestionably will continue its rapid progress, and eventually great fortunes will be earned for investors in aviation stocks, but the more conservative bankers are beginning to voice the warnings which were so often heard during the early stages of development in the radio, automobile and electric refrigerator industries. In an industry so young no one company can be assured of its future. In other words, all aviation stocks must be considered speculative in character. Naturally, the degree of risk varies with each company, from those which have no more merit than a wild-cat oil venture to several whose records indicate that with continued national prosperity, they will soon be worthy of ranking with the best industrials.

Financing operations in the last month show some companies issuing stock and thus offering the public a share in their fortunes, while others are retiring preferred issues and, thereby, improving the condition of their common stock.

The Travel Air Company, control of which was recently acquired by Hayden, Stone & Company and Jackson & Curtis, has made application to list 100,000 no par value shares of capital stock on the New York Curb Market. This is the first step taken since the control of the company has passed into the hands of these prominent bankers to make available to the public these securities.

The Lockheed Aircraft Company, who recently increased their common stock from 25,000 shares to 150,000 shares of no par value, offered warrants to subscribe to additional stock at the same time, and will use the proceeds from this financing to call in all of the preferred stock outstanding, which will make the common stock the senior issue. The Company will also utilize part of its newly raised funds to pay off its current indebtedness and the remainder will go for the construction of an assembly plant

near Chicago. The warrants, which were issued in connection with this financing permitted stockholders to subscribe to 5 new shares for each old share held, at $6 per share.

Mergers and consolidation are constantly being discussed in the industry. Each one accomplished is a healthy sign as it is evidence of the formation of larger and stronger units and the consequent elimination of competition. It is impossible to look at the aviation industry today and not draw comparisons between it and the motor and railroad industries as they were in the early stages of their development. Everyone knows the trials and hardships which both the railroads and the motors went through before they attained their present enviable positions. One can hope for no better examples for the aviation industry to follow than these, and it seems safe to assume that the aviation industry will benefit enormously by the experience of its predecessors in the realm of transportation and manufacture.

The Sperry-North American Aviation, Inc. merger has been of recent interest. The result of this merger was the sale of the Sperry Gyroscope Company to the North American Aviation, Inc., the largest of the aviation investment trusts. What price was paid or what the terms of the sale were is not known as the Sperry Company was privately owned, but the business is believed to have been worth several millions of dollars. North American will continue the operation of the Sperry Company along its previous lines with special emphasis laid on the establishment of experimental laboratories, where an effort will be made to improve the already highly technical and perfected instruments which are so vital to the successful navigation of a plane, and in which line the Sperry Company excels.

The Universal Aviation Corporation, a recent consolidation of several companies, has acquired the Continental Air Lines, Incorporated, and will incorporate this system as the first unit in the proposed southern cross-continental route. This is considered a valuable addition to the array of companies which have gone into the making of the Universal Company.

Several new companies have been established. An important new company formed recently is the Air Investors, Inc., which has been organized as an investment trust to deal in and finance aeronautical companies of any description. Its officers are men well-known in various lines, chiefly public utility executives, and every indication is that it should have a successful future. The present capitalization consists of 250,000 shares of convertible preferred stock, of which 60,000 shares are outstanding, followed by 1,500,000 authorized shares of no par common stock of which 140,000 shares are outstanding.

The Curtiss-Reid Aircraft Company, Ltd., was formed recently to acquire the assets and business of the Reid Aircraft Company, Ltd. The Reid Company was a Canadian organization formed only a few months ago for the purpose of manufacturing light airplanes, for which there has been an increasing demand in Canada. The Curtiss Aeroplane & Motor Company has purchased 50 per cent of the common shares of the Curtiss-Reid Company, giving it complete control. Capitalization of the Company consists of 42,500 shares of preferred stock issued at $30 per share with warrants, and 100,000 shares of no par common. The Curtiss-Reid Company has entered into a contract with the Curtiss Aeroplane Export Corporation for the sale of the Reid "Rambler" plane in Latin America.

An announcement has just been received that the Curtiss Aeroplane & Motor Company and the Caproni Airplane Company of Milan have formed an organization to build Caproni seaplanes and airplanes in the United States. According to the announcement, both the Curtiss and Caproni Companies will own substantial blocks of the stock of the new company and some financing is expected in the near future in connection with this deal, but further definite information is lacking.

No financial balance sheets are available for 1928 as yet, but numerous statements regarding the production of planes

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for various companies have been authoritatively made. In no case have we seen a statement which does not predict an increased production of at least 100 per cent, and some companies claim a far greater increase even than this. The market for this production may be even greater should the economic prosperity of the country continue, but by the same token, should the credit stringency grow to such proportions that business will feel the scarcity of funds, then the aviation industry, like every other, will suffer, and the sanguine predictions which have been made will not be justified.

Book Reviews

The story of the rescue of the Nobile polar expedition, a manual of radio, and a book for boys concerning the adventures of a stowaway aboard a transoceanic airplane, are on the display shelf this month. It is interesting to consider the variety of interests which fall within the classification aeronautical. Aviation is satisfactory in a romantic way, very largely perhaps because of this diversity of its application, and the almost unlimited number of angles from which it can appeal. This fact is well borne out by the character of the books covered from month to month in this department. A case in point would seem to be Mr. Giudici's account of the catastrophe of the Italia. Here beauty, hardship, science and sheer adventure are all inextricably mingled with the basic aeronautical element.

THE TRAGEDY OF THE ITALIA, by Davide Giudici. Pub. by D. Appleton and Co., New York, 1929. 208 pp. Illus. Price, $3.00.

At 1 a. m. on May 24 the dirigible Italia, bearing General Nobile and fifteen members of his expedition, arrived over the North Pole and for more than two hours cruised in the vicinity. An Italian flag was dropped onto the ice, a gramophone played Italian tunes, and the leaders of the expedition shook hands. The return journey was begun and it proceeded normally enough for the first few hours, though increasingly violent winds and a gradually lowering temperature caused General Nobile to consider strongly the advisability of returning to Alaska or Siberia rather than to Spitzbergen. It was determined at last to continue in the direction of King's Bay, but the fog became thicker and thicker, until the Italia ultimately found herself flying blindly through sleet and heavy mist.

At about 9:30, some thirty hours after the Italia had left the Pole, the elevator stopped functioning and the airship lost altitude. This difficulty was speedily removed, but within an hour the ship again

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began to fall, and in spite of desperate efforts on the part of the crew to throw out sufficient ballast to compensate for the rapidly decreasing buoyancy, the Italia swung swiftly downwards. The control cabin struck the ice with a terrific shock, breaking off from the envelope and smashing to pieces.

Relieved of the weight of the cabin and its occupants, the remainder of the balloon, still carrying six men, bounced back into the air and was blown rapidly away from the wreckage and the castaways. Five of the ten men on the ice were injured, one of them so badly that he died without rising. While the others were picking themselves up, and doing what they could for the injured men, they saw a column of smoke suddenly rise a long distance away to the southeast. This was the last sign of the six men who had been carried off in the wrecked dirigible. Two months later eight of the original sixteen men on the Italia at the Pole had been rescued, two had died, and six had completely disappeared.

The Tragedy of the Italia, as related by Davide Giudici, special newspaper correspondent on the ice-breaker Krassin which effected the rescue of all the men stranded on the ice-floe except Pomella and Malmgren, who had died, and General Nobile, who had been picked up by Lundborg in an earlier attempt at rescue with an airplane, records the efforts of the civilized world to find and restore to their homes the members of this ill-fated expedition. It is an absorbing story, not only because of the tenseness of the situation which it describes, but also because of the character of the rescue operations themselves. Planes, ice-breakers, dogsledges, and even snowshoes and heavy hiking equipment were called into service by the different groups trying to reach the marooned men.

The voyage of the Krassin, and the partial success of its mission, make a story of genuine interest. Only less interesting than the narrative of the actual rescue itself is the account of the organization and activities of the several relief expeditions which were fitted out on behalf of the Italia castaways. Mr. Giudici's book is the testimony of an eyewitness and participant, and it should have permanent value as a chronicle of one of the major episodes in recent Arctic adventure.

THE RADIO MANUAL, by George E. Sterling, edited by Robert S. Kruse. Pub. by D. Van Nostrand Co., New York, 1928. 666 pp. Illus. Price, $6.00.

The Radio Manual, by George E. Sterling and Robert S. Kruse, contains considerable material of interest to persons of aeronautical tendencies. It appears to be intended as a sort of household guide to radio, with comprehensive and accurate information on almost every phase

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Model 273—White soft garbardine, unlined. Each $2.00.

Model 260—Tan soft garbardine, unlined. Each, $2.00.

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And climbs 200 feet when equipped with this motor. It has many uses such as running an ordinary canoe, small row boat and light motorcycles. It is just what model plane builders have been looking for. It is an engine that will make their models fly.

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of the topic. Possibly one may say without being misunderstood that this manual effects a very happy and desirable compromise between unintelligible accuracy and inexact simplicity. The merit of the book lies in the fact that it manages to be useful to amateur and professional alike, and for this reason it should find a place in every well-rounded aviation library.

Of particular interest to the aeronautical reader is, of course, the chapter on radio beacons and direction-indicating apparatus. This chapter explains the theory behind radio-directional appliances, and then discusses in some detail the practical installation of sets both on the ground and in aircraft. Circuits and hook-ups are illustrated, and the utility of such information will be apparent to all those who have from time to time had reason to wish for more complete or sympathetic advice on these matters.

Other chapters discuss elementary electricity and magnetism, motors and generators, storage batteries, and charging circuits, the vacuum tube, fundamental tube circuits for transmitters, modulating systems used in broadcasting, general broadcasting equipment, arc and spark transmitters, commercial radio receivers, amateur short wave apparatus, radio laws and the handling and abstracting of traffic.

The Radio Manual is a good and useful book, clearly deserving the recognition which it seems fairly well assured of finding among persons with the curiosity or need to find out precisely how various radio devices work.

THE NON-STOP STOWAWAY, by Clayton Knight. Pub. by the Buzza Co., Minneapolis, 1928. 160 pp. Illus.

Books for boys in the field of aviation are not wanting, but books with the double appeal of narrative interest and technical plausibility are unfortunately, by no means the rule. The Non-Stop Stowaway, by Clayton Knight, can be applauded as an exception. Mr. Knight is an artist who writes, or a writer who draws, for he does both so successfully that it is difficult to determine which is his major distinction. In addition to these qualifications Mr. Knight has a flying record which lends conviction to his writing. He was a pilot at the front during the war, and he knows aviation as a participant rather than as an admirer. Consequently his writing keeps faith with the practical facts encountered in flying.

A purely imaginative element has been introduced into the story with the device employed by Mr. Knight to convey his characters into a heaven intended exclusively for flyers,—a sort of Happy Flying Field, so to speak. The idea is delicate and attractive.

The story concerns itself with the adventures of a boy whose father is preparing for a non-stop flight to India. After certain exciting preliminaries, all is ready for the take-off. The boy climbs into the fuselage, aft of the gas tank, and rides away with his father and the navigator on the India attempt. What happens is beyond the province of a reviewer to divulge.

The book is illustrated by Mr. Knight, and the drawings are pleasant and effective.

Lost—A Pilot

Anyone knowing the address of Thomas J. Dean, American pilot in Mexico during the years 1915 and 1916, is requested to communicate with Ernest Jones, 4527 49th Street, Washington, D. C. The information will be greatly appreciated.

School for Airport Engineers

(*Continued from page* 78)

est competition between air transport companies in the equipment they use. Planes carrying from four to six passengers were of fairly general use in 1927. Planes carrying from 14 to as high as 32 passengers will be available in 1929, and will be in service on practically all of the air passenger lines.

Such planes will be available as fast as a corresponding interest and patronage is developed on the part of the public. In this connection, Mr. Kemp said the part that women were playing in the progress of aviation was unusual.

"A point of interest will be the fact that women, who have always made every luxury a necessity, are the most enthusiastic patrons of air lines, and have already formed a large and growing percentage of the air patronage. This is especially interesting because their patronage forces upon the carriers a type of equipment far more refined and much better appointed than would be necessary were all their passengers of the sterner sex. Planes must be clean and comfortable. In fact, even now, the Universal have a parlor plane on which buffet luncheons are served. A reclining couch may be hooked up or taken down during flight while one takes a nap. The fact that they do not have to wear any unnecessary clothing, as the planes are heated in the winter and are delightfully cool in the summer, is continually prompting letters of appreciation from our feminine patrons.

"One young lady missed the Century for New York and learning of the Univer-

sal service, took the afternoon plane from Chicago for Cleveland. It developed that she was to appear in a New York opera performance the following day. She was so happy because there was no sensation of fear and the surroundings were so congenial that during the two hours of the flight she treated the patrons to various arias. Another young lady was so impressed with the pilot of the plane that she suggested it be made a rule of the company to always introduce the lady patrons to the pilots.

"Patrons on our planes have been of almost every age from 2 months to 92 years old. The youngest lady to fly on the Universal ships was a two months old miss whose mother was taking her to Cleveland via plane because her doctor had advised it—saying it would be quicker, more interesting, and less trying for the mother than the same trip on the train."

The transport pilot will no longer be quite the same romantic figure he has been in the past. He will begin to assume the standing and position of the captain of a large passenger liner. The air transport companies choose for their pilots the men who have spent the most time in the air. Officials have learned that maturity of judgment which comes with hours of experience in the air can not be duplicated in any other way. Following the example of the railroads, the air lines are selecting their oldest men to pilot their passenger planes.

Mr. Kemp has been actively encouraging aviation in Chicago since 1920. When the War broke out he had the same hope of becoming an aviator that many other youth of the land had. He was at Fort Benjamin Harrison, Indiana, until the opening of the first ground school at the University of Illinois. Entering the wholesale building material business after the war, he was so successful that he was able to devote time and effort to organizing the Chicago District Air Corps Reserve, which was the first of its kind in the United States.

The men who formed the Air Corps Reserve were aware that the formation of an adequate airport close to the center of Chicago was hopeless, unless the

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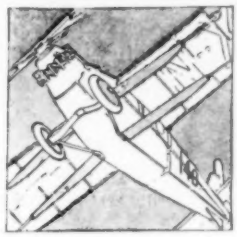

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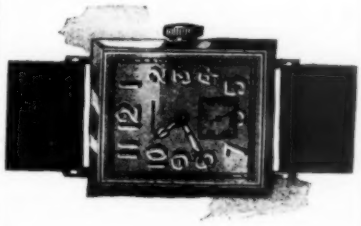

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municipality helped. Chicago because of its position as a world railway center, and its certainty of becoming a world shipping port on completion of the waterways to the seaboards, seemed to have advantages which would make it a world airport were the landing facilities furnished.

On December 24th, 1924, the City Council, acting under the direction of Mayor Dever, authorized the formation of the Chicago Aero Commission and Maj. Kemp was appointed Chairman of that body. The present Municipal Airport was recommended as a round house for storing and servicing planes, and the proposed Lake Front airport was recommended as a beautiful park for landing passengers and mail.

In less than three years of use, the Municipal Airport of Chicago has developed until it has more landings and take-offs per day than any other airport in the World. There are more miles of regular scheduled flying from the Municipal Airport than from any airport in the World. The centralization of air mail lines around Chicago, with Chicago as the hub, has made this possible. Since the recent purchase of the Continental Air Lines and with several additional airroutes in process of survey, the Universal Air Lines System alone is flying over 5,000 miles per day—more than the total mileage flown daily by the Imperial Airways of the British Empire.

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NAME .....
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Sailplane Construction

(*Continued from page* 74)

discussed in the later theoretical treatments.

The general construction is shown in Fig. 1. The supporting wing is designed in two sections; each wing-half has a span of 5.5 m. or 18 ft., two I-beams of plywood pieces and spruce girths, ribs of spruce ledges in triangular connection, and also diagonals between the beams for reinforcement against torsional stresses. Between two ribs is always an auxiliary rib, which reaches only to the second beam and serves merely for maintaining the front edge of the profile. The transversal rudders are jointed directly to the rear beam. Steel plate fittings are used to connect the wing halves to the fuselage frame, and steel tube stays coming from the beams to the frontal lower junction point serve for bracing, being connected also by means of steel plate fittings. The fuselage frame itself consists of a frame work of spruce supports, of which the lower longitudinal carrier is utilized for building the runner. The lower part of the fuselage frame, which must take up the shocks in landing, is planked on both sides with plywood. The lateral fin is connected organically with the fuselage frame and carries a non-compensated rudder. The altitude fin runs straight through and is reinforced with steel wires. All rudders are actuated by means of ropes.

(To be continued)

The $ Sign on the Airplane

(*Continued from page* 68)

lines which already are being developed within the aeronautical industry.

"Selling the Doddses is a trifle different and not a little more difficult, but once they are sold the percentage staying that way is very great and growing by leaps and bounds each day.

"First of all, the salesman finds it necessary to gain an audience with Dodds. He can not crash the Dodds office gate with a plea that in ten minutes time he can show Dodds how he can save his firm annually a staggering sum through use of an airplane. This would be putting the wrong foot forward with a bang!

"Dodds is a business man—and he's a mighty successful one. And as such, he'll listen to any story which is a story of dollars. He should be approached from

this angle and told at the start that he must be prepared to spend a few dollars' worth of his very valuable time listening to a story, which, if it proves agreeable to him, will show him the way to more dollars.

"Nothing spells success like success. Dodds is interested in the activities of a competitor because that competitor is making dollars he would like to have in his own particular field. He is interested in the business moves of other successful business men in all other lines of endeavor. All are chasing dollars, and brothers under the skin, in this respect, watch each other.

"So, the airplane salesman must present very necessarily the story of the successful use of aircraft in business by other business men. And, today, these stories are as lacking in the spectacular and the unusual elements as those of yesteryear when motor trucks were replacing ol' Dobbin at the helm.

"The story of Dr. Smith, who flew an airplane a year on trial between his home city and another where he was chief of staff of a hospital and did so at a saving of $12,000 in money and time, can be cited. Then, there's the story of the R. & D. Company, whose airplane carried its representatives over regular routes in an otherwise difficultly traveled territory at a saving of many thousands of dollars in a year and with the additional result that many other thousands of dollars came into the coffers of the firm through contracts gained by being first on the ground for negotiations.

"These and many others can be laid before Dodds as a forerunner of the bigger program. This should be an offer to conduct a survey for Dodd's company, setting forth actually in cold, hard cash figures just what his concern can gain by use of an airplane.

"Such a survey would show a comparison of the routes traveled on the ground by the company's representatives and by air; the differences in time and travel costs; point to point distances by air as compared with rail or motor car; time advantages gained at either end of the line by those engaged in the travel.

"Presentation of such a survey should include tables and explanatory matter. It should be concise and yet present the true picture. It should be submitted in as many copies as are necessary to go around the director's table.

"Because this survey is a proposition of dollars incoming it will be given every consideration. A request for demonstration of the salesman's plane very probably will be the next he hears from Dodds. And, of course, this can be arranged satisfactorily. A good idea would be to offer to fly one of the company's representatives over a regular trip route as a part of the demonstration.

"There are other details to be attended to, but this, essentially, is the outline to follow in general. It is the easiest, surest and most satisfactory way to sell a plane to Dodds and once he is sold he will be a repeater on the sales book of aircraft producers just as surely as he is on those of motor car dealers.

"The alert salesman will find other ways of presenting his story. To some, already thoroughly airminded, the salesman will not find it necessary to present a survey of the airplane needs of a concern. He will find, also, that one sale in a city will lead to others, for other business men, noting the successful use of an airplane by their fellows, will investigate and many times buy planes, too.

"Merchandising of aircraft today must be focused on the dollar value of the ship to the purchaser. Maintenance of aircraft is not excessive. It has been shown it costs less actually to operate a plane over a regular route than a motor car.

"Show the business man or firm executive where an airplane means dollars to him and he will listen to your story—and buy! The dollar value of the airplane today is its biggest selling talk."

Duralumin Propellers

(*Continued from page* 54)

on the part of the alloy, which tendency is due to the metal's unusual brittleness. Magnesium is superior to aluminum in elongation properties and hardness, but is inferior in strength.

A situation which has contributed to the slow development of the industry in the United States is the fact that the only important manufacturer in the country is controlled by a trust, which itself is known to have a practical monopoly in the aluminum industries. Until a more evident competition develops in these two fields, or congressional investigations succeed in remedying the situation more than they have done in the past, progress will be slow, and we can expect European aircraft organizations to leave us behind in the severe struggle for supremacy of the air.

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Model Builders' Department

Conducted by Bertram Pond

A NUMBER of the readers of POPULAR AVIATION AND AERONAUTICS have been sending in from time to time some fine pictures of models which they have built. Many of them have sent us fine letters telling how much they have been helped by the articles in this model section in the construction of their models. Others write that they have been greatly enlightened regarding the origin of most all of the model airplane design features used in the successful model airplanes of today. A large number have written us that they are building the model scales described in the January issue. Some have completed the scales and tell us that they find them one of the greatest helps in building models of record proportions that they have ever used.

Be sure to notice the fine picture printed with this article of an uncovered model of the English Avro triplane cabin job. When covered with Japanese tissue paper this model was one of the prettiest little flying scale models that the model editor has ever seen. The extent to which the details were worked out in this model is evident from the picture. This model flew between 25 and 30 seconds indoors, covering the full length of the huge International Amphitheater at the Stock Yards in Chicago, and finally crashing into the wall. It could have flown 10 or 15 seconds longer if the flying area had been larger. The machine was built and flown by the former holder of the world's model duration record, Mr. Robert V. Jaros, of the Illinois Model Aero Club. He won the first place in the scale model contest in 1920 with this fine little ship, but even today it is seldom equaled in workmanship and flying ability. The model is made of spruce, bamboo and balsa wood. Every joint in it was tied with silk thread and glued, a huge undertaking in itself. This machine has a detachable motor base and nose piece, permitting the motor stick and motor to be removed for winding with a winder. The left and right wings are arranged to come off in a manner quite similar to that used on large airplanes of today. This permits the model to be packed in a small carrying case. The span of this model is approximately 30".

Send to the model editor any good clear pictures you may have of your scale models along with a brief description, such as the span of the model, materials used, prizes you may have won, and the best duration and distance records which you have made. If space permits, we will publish these from time to time in the model department.

Uncovered flying scale model of an English Avro triplane.

Wing Curves for Model Airplanes

There are a number of good wing sections for model airplane use. However, a wing section which may be entirely suitable for high speed airplanes may not be satisfactory at all for a model plane. This is the case with the Clark "Y" wing section. Models can be made to fly very nicely using this section but because of their slow speed and the different conditions under which they operate, it is possible to improve the performance of any slow model using the Clark "Y" by careful selection of a different wing section.

A good section for a model airplane wing should have a small center pressure travel, a high lift to drift ratio and a relatively high lift.

By center pressure we mean the distance which the center of lift moves from one point of the wing chord to another when the wing is set at different incidence of angles.

By lift-to-drift ratio we mean the ratio of the lift of a given wing area to the drift required to pull this wing through the air.

By maximum lift we mean the greatest lift which the wing will produce at any angle.

The governments of various countries throughout the world as well as schools and manufacturing companies, have taken it upon themselves to erect wing tunnels for the purpose of testing these characteristics of wing sections and to gather aerodynamical data on bodies, floats, struts, complete airplanes, models, etc.

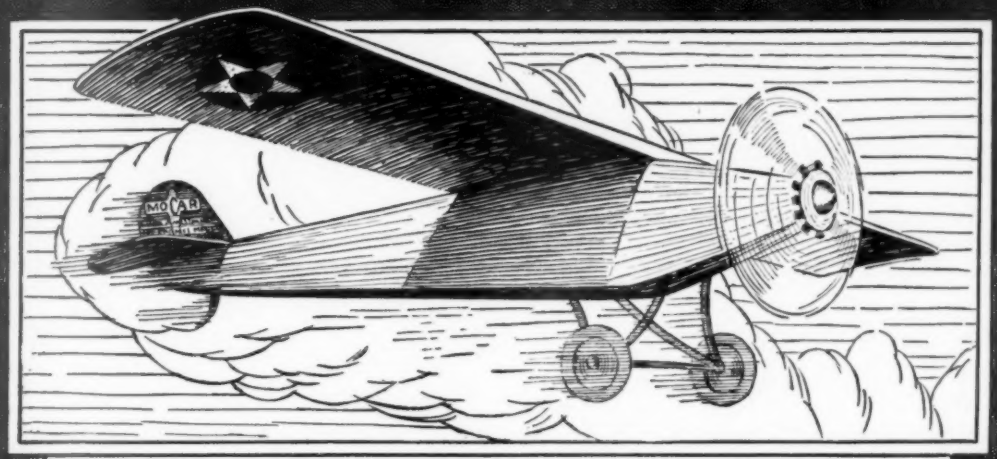
From the wing section data which is published in this country in pamphlet form by the National Advisory Committee of Aeronautics an airplane designer can calculate beforehand the probable performance of his airplane with considerable accuracy. In the same manner it is possible for the model plane builder to calculate the performance of his model in advance.

It is suggested that those who are especially interested in this subject should read the chapters in some of the books on aeronautical engineering and should get some of the latest reports from the National Advisory Committee of Aeronautics. You will find a number of very interesting topics discussed though you may find it difficult to weed out the information you desire from the numerous and advanced mathematical formulæ, calculations, and equations which accompany some of these books.

Note that wing sections tested in one laboratory may not test the same in another laboratory due perhaps to the speed of the air used in the tunnel, errors in test, the density of the air at the time the test was being made and the size of the wing or model being tested. However, wing sections tested in one laboratory should have the same relative values or be in the same order as the same set of wing sections tested in another laboratory though the lift and drift values may

XUM

The MOCAR



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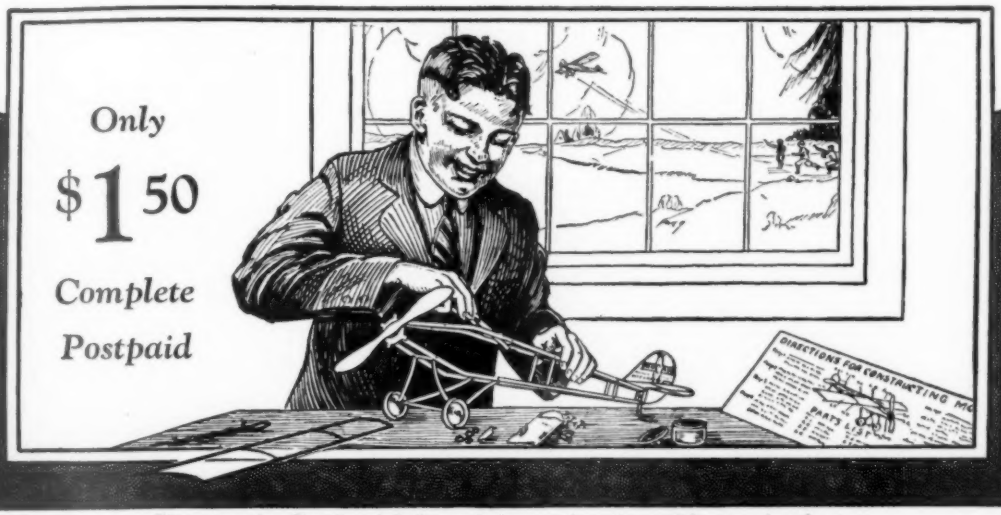

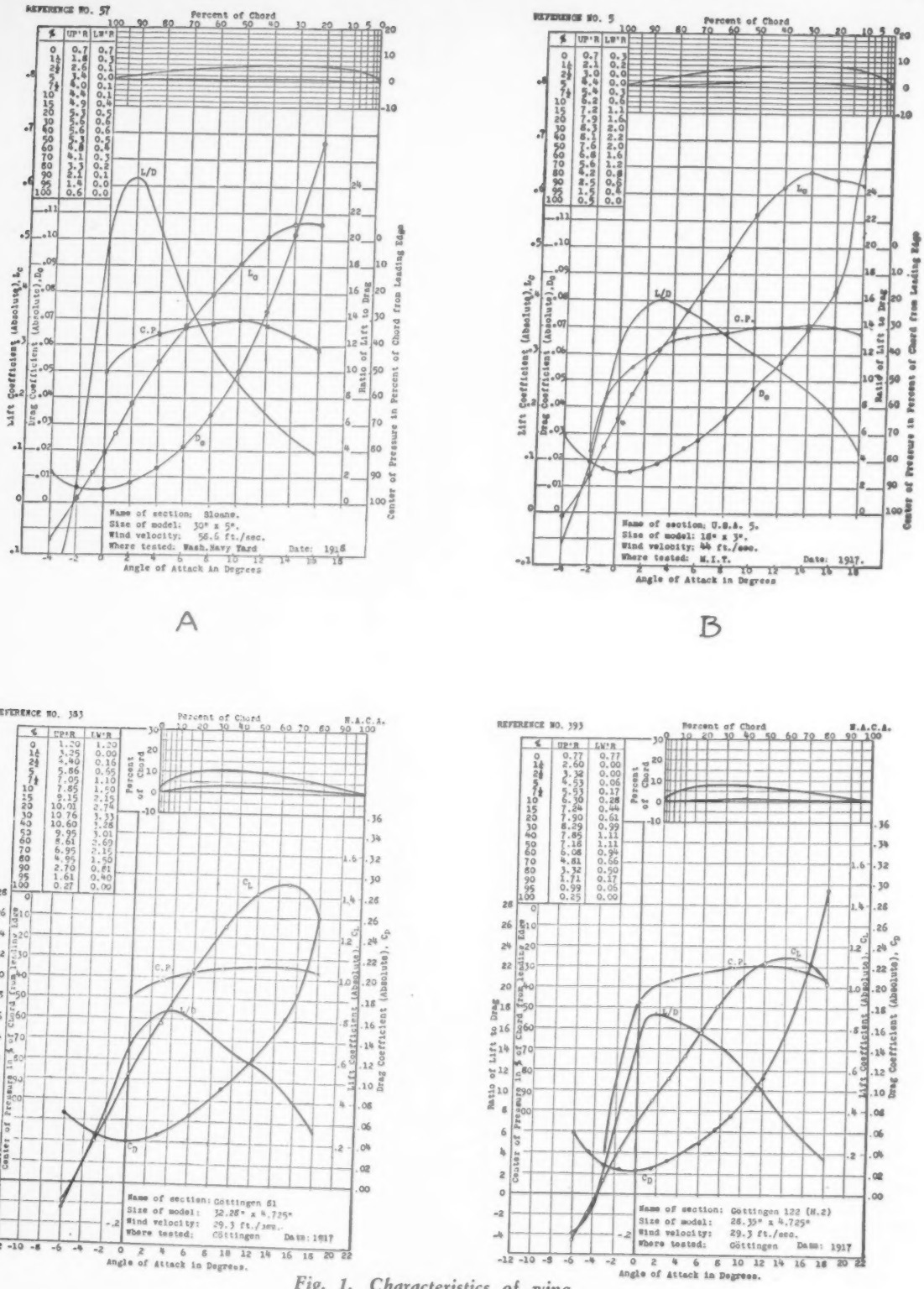

Fig. 1. Characteristics of wing sections as plotted and published by the National Advisory Committee for Aeronautics.

be lower or higher according to the characteristics of the wing tunnel, etc.

The model builder can very easily and accurately plot his specified or chosen wing section by using a piece of cross section paper and plotting the points given on the wing section reports in the upper left hand corner. These points are given in the table in percent of chord. Let us take for example the Sloane wing section which is graph A in Fig. 1. At 10% of the chord you will note that the curve of the upper surface passes through a point 4.4% of the chord in height above the base line, and that the curve of the lower surface passes through a point 0.1% of the chord above the baseline. By plotting all of these points in this manner and drawing a smooth curve through them, you will have the same shape of curve which is included with the report in the upper right hand corner. By plotting the curve yourself you can make it very accurate and to any desired size to suit the needs of your model.

Tractors and twin pushers require slightly different wing sections. In order to obtain stability and efficiency it is advisable to pick a tractor wing section with a fairly high lift to drift ratio at an incidence angle of four to six degrees. A section suitable for tractors is the Gottingen 81 shown as graph C below.

For twin pushers the wing section that has a high lift factor combined with a maximum lift to drift ratio occurring at about 0 to 2 degrees incidence is most desirable. Such a wing section is shown in graph D. It is the Gottingen 122.

There are numerous other sections as suitable as these and some perhaps even better for model work but these were picked at random to illustrate the selection and use of wing sections from tables and reports.

In conclusion let me stress the point that for a final choice a wing which has a high lift is to be preferred over one with a smaller lift even though the one with the smaller lift may have a slightly greater lift to drift ratio. The reason for this is simply that a smaller wing and consequently less weight is required to lift the machine if you use the wing section with the greater lift. The result in your final design will be that you will have a more efficient machine because of this compromise.

Helicopters

Ever since the first man carrying airplane was successfully flown and even before, men have been trying to build and fly helicopters. In fact, it was a toy butterfly helicopter which gave the Wright brothers their early inspiration to attempt to conquer the problem of human flight.

We are all familiar with the "five and dime" store variety of toy helicopters

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Complete Construction Outfit Containing Everything Required **$6.00**

IDEAL Scale Models of Famous Aircraft are known everywhere as the most realistic, most practical and most satisfactory flyers. Complete Construction Outfits for "SPIRIT OF ST. LOUIS", FOKKER, DEHAVILLAND, CURTISS, Naval-Curtiss SEAPLANE, NIEUPORT and BLERIOT Monoplanes; CECIL PEOLI Racing Airplane. Full details of these Models given in catalog mentioned below.

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IDEAL AEROPLANE & SUPPLY COMPANY, Inc.
Largest Manufacturers of Model Airplanes
Established in 1911

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64-page Catalog—5c

Tells how to build Gliders and Racers, gives full information about Scale Models, and contains most complete listing of Parts, Fittings, Materials and Supplies for all kinds of model aircraft. The biggest and best Model Airplane catalog obtainable.

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Complete Plans and Instructions for any one of the following Models sent for 25c; New York-Paris (Spirit of St. Louis); FOKKER; DeHavilland; Curtiss; NC-4 Seaplane; Bleriot, Taube or Nieuport Monoplanes; Cecil Peoli Racing Airplane. Catalog included free.

When you build model planes and gliders, use Balsa Wood

Commercial builders make their planes from Balsa Wood—it is the lightest wood known, yet weight for weight strong as pine. Its resiliency like that of spruce. We have Balsa Wood pieces cut in special sizes for the builder of model planes and gliders. Prices as below.

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Length	Width	Thickness	
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36″	6″	3″	1.75
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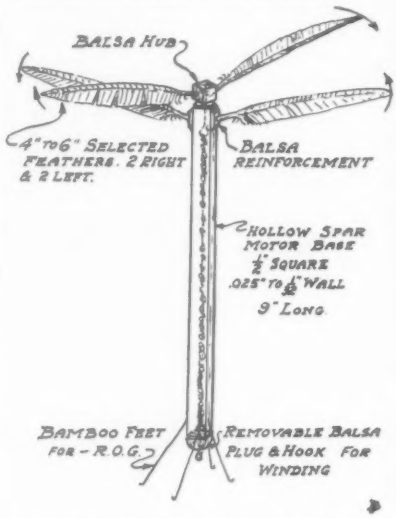
245 11th St.

Write for our free booklet on model construction

which depend for their flying ability upon the momentum with which the metal propeller is twirled into the air. Some of these are sent off from a twisted flat rod, others are started by twirling them with a string wound around a spool. An early pattern was operated by rotating the round propeller shaft quickly between your two hands.

Still another type was one in which the propeller was so arranged that it was rotated by the tension of a whalebone bow. Strings wound around the propeller shaft from the tips of the whalebone bow gave sufficient power to the propeller to cause it to lift the total weight of the machine for a short space of time.

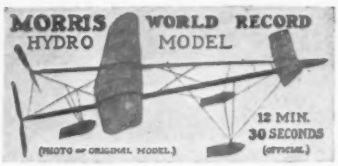

BALSA HUB
4" TO 6" SELECTED FEATHERS. 2 RIGHT & 2 LEFT.
BALSA REINFORCEMENT
HOLLOW SPAR MOTOR BASE
¼" SQUARE
.025" TO ⅛" WALL
9" LONG
BAMBOO FEET FOR - R.O.G.
REMOVABLE BALSA PLUG & HOOK FOR WINDING

Four feathers, a stick, and the inevitable rubber band make a flying model helicopter.

In 1922, the model editor constructed a simple rubber band operated helicopter using four feathers for the propeller blades and a hollow balsa spar for the motor base. Two of the feathers were fastened to the propeller shaft to form a low pitch propeller and two of the feathers were fastened to the motor base so as to form a low pitch propeller rotating in the opposite direction from the one attached to the propeller shaft. (See the sketch.) A duration of 12 seconds was accomplished by this helicopter using feathers and balsa wood.

The model editor paid a visit to the Illinois Model Aero Club recently and was pleased to learn that the record of this feather driven helicopter had been broken a number of times recently by some of the members. Their best time to date stands at about 37 seconds. This is a very good time for a craft of this type. In fact, I believe that many of the readers of the model section would have doubted the possibility of building a rubber driven helicopter to fly even half this time. The helicopters used by

BUILD A GENUINE



KIT everything you need, wire parts formed, select balsa, large drawing, full instructions, only $3.00 or $4.40 with carved propellers—postpaid. Flies as well with wheels or hand launch!

PICTURE, 5″x7″ clear close-up—postpaid $1.00.

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SUPERFINE JAPANESE TISSUE — Smooth, tough, extra light, 18″x24″. Order 5@$.55 or 10@$1.05.

BEAUTY WINDER—5 to 1 ratio, solid, smooth operating, heavy duty. Others charge $2.50. Our price $1.75 postpaid.

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COMPRESSED AIR MOTORS—Oh Boys! Make real engine driven planes! 3 cyl. motor w't. 1½ oz. only, $4.90 postpd. or all parts & print only $2.50. Special air tanks, $10.00. Tank parts and print, $5.00.

RUSH ORDER TODAY!

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Build all kinds of models! Win prizes, break records, using our "I" beams, "dopes," light bearings, wheels, ribs, etc. Commercial models, Spirit of St. Louis, etc. Save $$.

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Send 5 cents for complete parts list. A 5 cent service charge is required on all orders amounting to less than $1. A 5 cent packing charge is required on all shipments of wood or metal greater than 18″ in length. Prices are subject to change without notice. All goods sent postpaid in the U. S. A. No stamps or C. O. D. orders accepted.

	Spruce	Balsa
1/16″x⅛″x3′	.03	
1/16″x 1″x3′		.06
⅛″x⅛″x3′	.03	.033
⅛″x¼″x3′	.045	.054
¼″x¼″x3′	.054	.06
½″x 1″x3′		.24
1″x 3″x3′		.48
1″x 3″x3⅛′		.56

Reed 6′ lengths, 1/16″ diam. .05c; ⅛″ .075c; 3/16″ .10c; Balsa discs ¼″ thick 2″ diam. .07c; 3″ .08c; 4″ .09c.
Ambroid dope, ¼ pint .50; ½ pint..... .95
Ambroid cement, 2 oz. .33; 4 oz..... .53
Bamboo paper 13x36″ .12; 24¾″x33¾″..... .14
Rice paper, 18″x24. .09; 21″x25″..... .06
Wood veneer, 20″x30″..... .22
Flat rubber 50′ of ⅛″, .50; 50′ of 3/16″..... .75
Piano wire 3′ of No. 5 or No. 8, .04; 3′ of No. 11 or 15..... .06
28-30-32-34 steel wire, per spool..... .10
1/16″ copper washers, 10 for..... .05

We can supply any size balsa that you need, also propellers, I beams, wing sections, bolts, nuts, screws, brads, aluminum, brass tubing, turnbuckles and books on model building.

AIRPLANE 12-inch scale model of Lindbergh's Spirit of St. Louis. Scientifically designed and very realistic. Equipped with rubber band motor. Rises from ground by own power and flies 30 ft. or more. Easily built without tools. Construction set, with all parts and full directions, postpaid in U. S., only 50c (no stamps). Satisfaction or money back. Send now.

Mann & Benton, 53 W. Second St., Chillicothe, Ohio

the members of the club are constructed in practically the same manner as the editor's 1922 feather driven job with the exception that they are propelled by means of featherweight balsa propellers arranged in the same manner and they have longer motor bases.

You should not be surprised if you see an announcement in the next issue or two of POPULAR AVIATION AND AERONAUTICS of the helicopter duration record being raised to 45 seconds and even a minute.

The members of the Illinois club are right up to the minute in developing helicopters. I wonder how many other model clubs will be experimenting along this line after seeing what success the Illinois Model Aero Club has had.

Write and tell the model editor all about your helicopter experiments. You may develop something which can be applied to man-carrying helicopters, making them a successful proposition.

The real problem in man-carrying helicopters of course is not in making them lift their own weight, as this has been done on a number of occasions with a man on board, but rather being able to control them and steer them accurately and easily at the will of the pilot. Who knows, you may be the one to develop this desired principle?

Sub-Arctic Gasoline Caches

(*Continued from page* 60)

plies is carried on by the company by plane as this is the fastest means of travelling in this lake studded country. Once the prospectors have been brought to a place where they are to look for copper or gold ore they are left with canoes to make their way around. Planes call in regularly for reports and additional supplies.

Two ski equipped cabin ships are flying throughout the winter no matter if the weather be clear or stormy to bring the results of the three main workings of the company in this northern Ontario district to the assay office which has been established at Sioux Lookout on the main trans-continental railway line. Two planes will fight their way through sub-Arctic blizzards and crystal clear weather averaging 30 below zero. Their duty and that of the pilots who send them winging over ice-covered lakes and snow-clad hills will be to bring the findings of the men who are working the mines during the cold weather to the assay office. The samples that are being wrested from the frozen rock must be rapidly conveyed in order to determine their commercial value.

All this is but the work of one company. There are many other mining companies in Canada which use the airplane for the transportation of men, machinery and supplies. But never has a company done the thing on such a grand scale, with such rapidity, and such organization as this company which in so doing has obtained a lead over any other mining enterprise in the Dominion to reap a big share in the unknown mineral wealth of Canada's sub-Arctic. Where next spring other companies will have to go into the field, perhaps not as extensively as this concern, and will also have to establish gasoline and food supply bases throughout their district, the twelve airplanes under Captain Oaks will be able to fly to the main bases already established and operate within a radius of four hundred miles of each base while still remaining in easy contact with the gasoline supply. Although minerals were found in some quantities this year the men did not go up with the hope of finding much mineral wealth. They went up to create temporary and permanent bases. Next spring the big drive begins.

Popular Aviation is now Aeronautics

This Big 1929 Outfit YOURS for Only $3

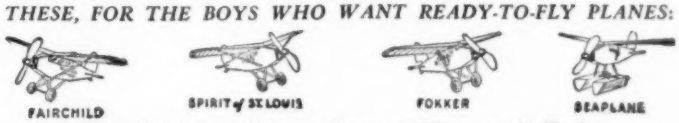
BUILDS ANY ONE OF 4 DIFFERENT MODELS

Contains a mammoth set of parts, plans and instructions to build a real flying model of Spirit of St. Louis, Fairchild, Fokker or Bremen. Rubber-tired aluminum wheels. Indestructible aluminum propeller and motor mount. Heavy, multiple-strand Para Rubber motor. Planes guaranteed to stand rough usage, and to fly 300 ft. if instructions are observed. Outfit, prepaid anywhere in U. S., $3.00. (Plans and drawings only 50c.)

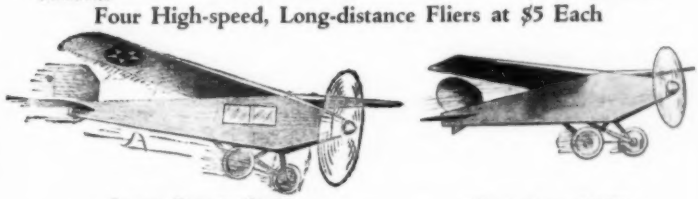
How About This Snappy Little $1 TWIN PUSHER OUTFIT?

All parts, drawings and instructions to make it, only $1.00. Has aluminum propellers, two powerful rubber motors, highly cambered 16" wing, and adjustable elevator. Makes a high-powered, long-flying job you'll be proud of!

THESE, FOR THE BOYS WHO WANT READY-TO-FLY PLANES:



Four High-speed, Long-distance Fliers at $5 Each



Army Scout, $3.50

Fibre wings and fuselage. Aluminum propeller and motor mount. Rubber-tired landing gear. 19" wing spread. Beautiful colors, accurate design, and a fine flier!

Contestor, $2.50

Built much like the Army Scout, but with 17" wing spread. Big favorite with boys all over the country.

Complete catalog of planes, 10c
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Clinton Model Airplanes

Build this Airplane Yourself

3 ft. model

BELLANCA *"Columbia"*

True scale, exact replica, guaranteed to fly, all materials and instructions. $9.00.

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Send for your copy of our 56 page booklet which contains the scientific knowledge we gained through 20 years experience in airplane model construction. It illustrates and describes famous airplanes, also all parts required by model builders, experimenters and inventors. This booklet is mailed to you upon receipt of..... **10c**

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Balsa or Spruce
1/16" x 1/8" x 3'.....0.03
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3/32" x 3/32" x 3'.....0.06
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For all other sizes and I beams send for free catalogue.
Bamboo paper 25¾" x 33½".....0.14
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ACE E. Z. BUILT FLYING MODELS

Bellanca Columbia - Spirit of St. Louis
42 INCH WING SPAN 39 INCH WING SPAN
WEIGHT 6 OUNCES WEIGHT 6 OUNCES

Flying models any boy can build. No steaming, bending, or drilling delicate holes. Machine ready to fly in 8 hours time. Other makes require 30 to 40 hours. Save time, patience and money. Have the following features of construction:

Fuselage is finished in thirty minutes. Balsa ribs (Clark Y section).

Aluminum cowling, aluminum disc wheels, balloon tires, feather weight ball bearing propeller shaft, lacquered propeller with aluminum spinner cap, dummy Wright whirlwind motor, split type landing gear with stub axles, demountable motor stick gives you distance flights, full size drawing with all details. Your choice of red, blue, green, or yellow model dope. Packed in a box 14x27 in. Postpaid $7.00.

33 INCH SPIRIT OF ST. LOUIS. Weight, 3 Oz.

Makes a very light flying model that will fly from 700 to 900 feet. Complete with finished balsa sides, balsa disc wheels, balsa ribs, jap tissue, ambroid, lacquered propeller with spinner cap. Drawing with directions. 2 ounces model dope. This machine is equal to others selling for eight dollars or more. Packed in a box 12x20 in. Postpaid $4.50.

ACE SUPER UNIVERSAL CONTEST KIT $2.00

Will build Morris Racer, Elliot Racer, Lange Racer, Stinson Detroiter. Described in the American Boy Magazine. 33 inch Spirit of St. Louis consists of 40 inch lengths of balsa 1/32, 1/16, 1/8, 3/16, 1/4 inch thick, model dope, super Jap tissue, ambroid, assorted bearings, washers, straight lengths of piano wire, 20 ft. rubber, blocks for propellers.

ACE UNIVERSAL CONTEST KIT $1.00

Will build 6 baby R. O. G. models, or 3 large R. O. G. or Commercial models or most any indoor type machine. Consists of 36 inch lengths balsa 1/32, 1/16, 1/8, 3/16, 1/4 inch thick, Jap tissue, model glue, piano wire, washers, bearings, model dope. The model builders favorite. Endorsed by leading scout masters.

Send Five Cents for Complete Catalog.
ACE AEROPLANE & MODEL SUPPLY
131 Prospect Street Jersey City, New Jersey

Question Mark Flight

(*Continued from page* 40)

the rear of the transport watched for any signals that either Major Spatz or Captain Eaker might give, and then passed them on through to the pilots of the transport.

It was something of a job for the men who handled the hose to keep in balance with the plane going up and down. When contact was broken, considerable power and force were required to haul the hose back, on account of air pressure. On making contact the refueling plane slid in from the side and the Question Mark came in from the rear and gained altitude until the right distance between the two planes was reached.

The purely physical aspects of the record flight may be stated simply.

The Question Mark took off from Metropolitan Airport, Los Angeles, at 7:26: 46 a. m., on the first day of 1929, and landed at 2:07:01 p. m. on the seventh day. During that time thirty-six contacts were made and 5,200 gallons of gasoline were burned by the three Wright Whirlwind engines. The Question Mark took on 21 tons of supplies during the long test and flew a total of 11,500 miles or nearly half way around the world.

The Question Mark is an army C2 transport built by Anthony H. G. Fokker and has a wing spread of 71 feet.

Meteorology and Safe Flying

(*Continued from page* 29)

Through an intensification of the service already organized, so as to provide—(a.) more frequent reports from a larger number of stations; (b.) more frequent and accurate airway forecasts; (c.) a prompt and dependable system of communications, including ground to plane. 2. Through research conducted by properly trained men in—(a.) the conditions favorable for the formation and for the dissipation of fog, haze and low clouds; (b.) the development of additional methods for making observations of upper air conditions in all types of weather; (c.) the conditions favorable for the formation of ice on aircraft; (d.) the conditions favorable for the development of gustiness, vertical movements and violent disturbances such as thunderstorms and line squalls; (e.) statistical data from which can be determined many useful facts, such as the approximate schedules that can be guaranteed for different parts of the country. 3. Through cooperation on the part of the pilot in—(a.) discussing frankly with the meteor-

SCALE MODEL AEROPLANES

The first and finest MOTOR DRIVEN Models

Types, Curtiss Sea Hawk Curtiss Racing Seaplane

Features: 4½ foot wing spread. 6-cylinder compressed air motor, will run 1½ minutes. Has shock absorbers like real plane. High efficiency propeller. Special rubber tired wheels. Special light strong wings. This is a sparkling model in every detail, each part is the finest to be had.

3 foot rubber driven models. $12.50 knockdown form. Spirit of St. Louis, Lockheed-Vega, Curtiss Sea Hawk. All special features on these models.

Send 10c for catalogue.

Miniature Aircraft Corp.
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Popular Aviation
is now
Aeronautics

Do You Make Good Models?

If you do you will eventually use Cleveland Blue Diamond supplies as the advanced model makers do. They realize **good** model airplanes cannot be made with the supplies usually obtained, but depend on selected material which passes experienced inspection.

The Cleveland Blue Diamond supplies are made of just such selected materials and are given final inspection before being shipped to our patrons, the advanced model makers. Get into their class now! Send 10c (coin) for price list of supplies and models.

Special for March—Complete kit with blueprint No. 314 Twin Conard (pusher) 37½" span. Four propeller blocks included. Choice of Balsa wood or W. Pine, postpaid anywhere in U. S. $2.45. No C. O. D. shipments.

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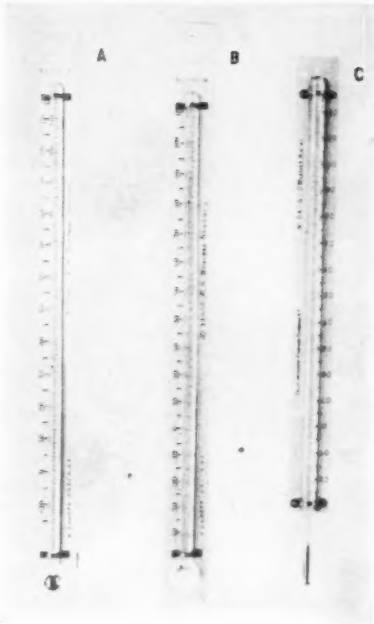
Model Airplane Specialists
1866PA West 57th St., Cleveland, O.

We are developing a new type 48" flying model. **Watch for announcement.**



Thermometers used by the Weather Bureau. The one at the right is being furnished to the airway weather stations.

ologist the problems with which he has to deal; (b.) telling the meteorologist whether or not his forecasts are correct, and, if not, wherein they failed; (c.) describing to the meteorologist the conditions through which he passes that give him most concern. Through cooperation on the part of the operator in—(a.) making suitable arrangements for the meteorologist to accompany the pilot in some of his regular flights; (b.) providing special flights during particularly interesting conditions; (c.) instructing the pilots to pay close attention to the weather reports and forecasts; (d.) criticizing frankly the service furnished, in order that it may be developed to the highest possible point of efficiency.

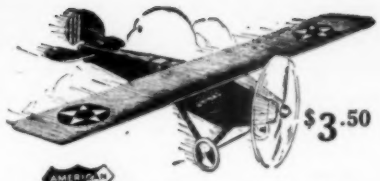
Those of us who believe thoroughly in the future of aeronautics, and the number is happily growing by leaps and bounds, foresee a development in the not distant future when it will occupy a prominent place in the commercial life of the nation, not supplanting but supplementing in a large way other types of transportation. This development means a similar expansion and intensification of weather service. Such service is possible, but, to be most effective, it must have the whole-hearted support of pilots and operators, it must be made more nearly perfect through research, and it must be of the up-to-the-minute type through a fast and dependable system of communications. With such a service functioning on all of the airways, the hazards of flight which now unfortunately, and in a large measure unjustifiably, loom large in the public consciousness will vanish, and by this cooperation between the pilot and the weather man, aeronautics will truly "come into its own."

The Small Airport

(*Continued from page* 14)

devices, popular use of air transport, aids to navigation, availability of land, convenience—all will have their influence toward bringing the airplane closer to those who are to use it.

And there is the private owner to whom thought must be given. He will be flying everywhere and anywhere, off and on the airways, seeking the byways of the air for his excursions. For him planes will land in the most restricted places, prepared and unprepared.



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Designed Like and Flies Like a

Real Airplane

Will fly beautifully and is extremely *durable* . . . good for many hundreds of flights without damage.

Has all-metal motor mount, sturdy wings, scientifically designed aluminum propeller and shock absorber landing gear with rubber-tired wheels.

The Scout Model shown above, well packed, will be sent prepaid anywhere in the U. S. for $3.50. Other splendid American Models are: Spirit of St. Louis, Fairchild and Fokker at $5, and the Bremen at $7.50. Every plane tested at the factory and guaranteed to fly and land like a regular plane. Order now and let the fun begin!

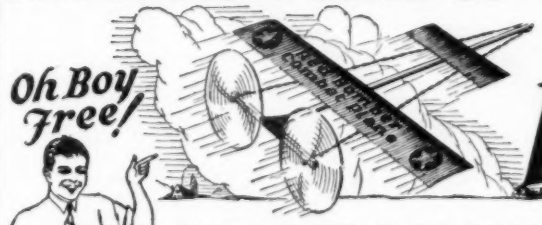
Glider Given With Catalogue 10c

AMERICAN PLANES

American Model Aircraft Co.

Dept. 1, P. O. Box 1492
New Haven, Conn.

The Red Bomber Combat Plane Free



Oh Boy Free!

Positively a sensational offer. Here's the Red Bomber Combat Model Plane, a twin propeller model that flies amazingly. And you can have it free! Boys everywhere are flying model planes. Now is the time to get yours. This sensational plane will fly 600 feet easily, often further. Wings made of special fibre, two powerful rubber motors, two cleverly fashioned propellers. Not a glider—**a real model plane.**

ASSEMBLED IN TWO MINUTES

Best of all no tedious hours of toil constructing. This plane can be put together ready to fly by any boy in less than two minutes—positively! Two minutes after the postman delivers your plane, you can send it into the air diving and dipping, zooming, banking, then soaring to greater heights. Every boy will envy you. Order your plane right now!

THRILLING BOY'S MAGAZINE

THE OPEN ROAD for BOYS has 50 pages or more every month crammed with stories of aviation, sport, ranch life, high adventure on land and sea, mystery and daring. Great serial stories, interesting articles, jokes and humor. International correspondence club, stamp department and THE OPEN ROAD PIONEERS—nationwide club for boys. Contests galore for all. New, hair-raising detective, mystery serial smash now starting—breathless reading!

Regular subscription price to The Open Road for Boys is $1 per year. We will send you the Red Bomber Combat Plane and a subscription for a whole year—12 fat issues—both for $1. Send the coupon now.

12 Big Issues A Year for YOU

This is A GREAT OFFER

Both *for* Only $1.00 *use this coupon*

Pilot Leeds
Open Road for Boys Magazine
130 Newbury St., Boston, Mass.

Friend: By all means I will grab this offer. Enclosed is $1. Please rush me the Red Bomber Combat Model Plane which I understand is free. Enter my name to receive a year's subscription—12 issues—to The Open Road for Boys Magazine beginning with the very next number.

Name .....

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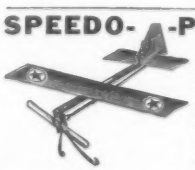
YOU'LL GET A PLEASANT SURPRISE!

SPEEDO-PLANE FLYER



Rises from the ground, soars to great height; comes down in a graceful glide to a perfect landing. Wing spread 16 in. Motor stick 14 in., 7 in. carved wood propeller. Match its performance against your $5 plane. Fully assembled. Only 50 cents postpaid in U. S.

SPEEDSTER AIRPLANE

Fast flyer. Rises from ground under its own power. Speeds beautifully thru the air. 11 in. wing spread. 9 1-2 long. 4 1-2 in. carved wood propeller. Only 25 cents postpaid in U. S.

Both Models Guaranteed to Fly or Money Refunded

Special for this month—Snappy, live rubber, 1-8 in. flat, 1-2 cent per foot; 3-16 in., 1 cent per foot. Postage 5c extra.

SPEEDO MFG. CO., Dept. A, 253 Albany Ave., BROOKLYN, N. Y.

Aerial Navigation

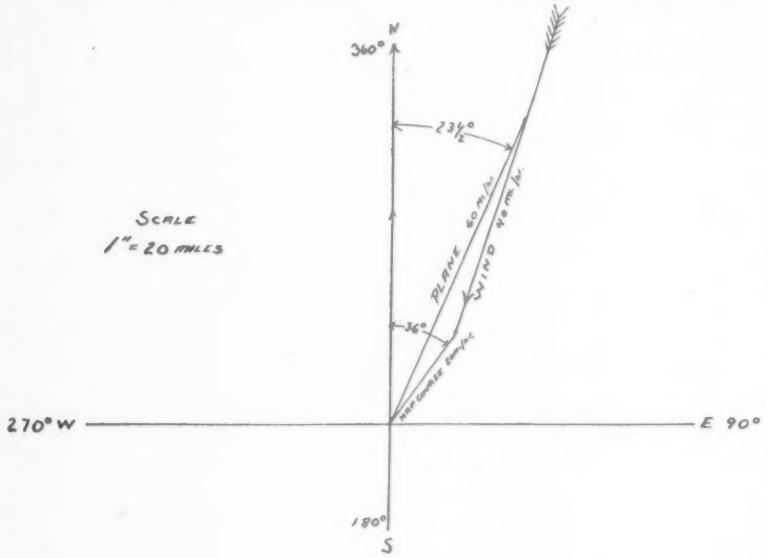
(*Continued from page 88*)

right and as in our example if it is desired to obtain a compass course from true course the error is applied to the left. To return to the problem we now have (1) the position of A and B, (2) the true course between A and B, (3) the compass course that we must steer to make good the true course. Everything is ready for a start and if we had a wind either directly ahead or directly astern we should make our objective with little trouble. Of course, with a tail wind our speed with reference to the ground would be accelerated and with a head wind retarded. Do not forget that a plane's speed through the air is not affected by the wind but only its speed with relation to the earth. If for instance the direction of the wind when we took off was S. 45° E. and it had a force of 20 miles per hour, the air speed of our plane was 100 miles per hour, and the distance from A to B was 200 miles we could calculate our drift graphically as in Figure 3 by "laying off" the amount of drift for two hours, i.e., 40 miles (2 hours at 20 miles per hour) in a S. E. direction to a point C. Then from C draw a line A C. The angle B A C will be the true course required to counteract the drift. B A C can be obtained by protractor or by inspection from a traverse table or solved by computation as a right angled triangle.

This example represents the simplest possible problem in drift. Under actual flying conditions drift is a factor that may vary as you proceed on your lateral course and according to your altitude. With modern drift instruments, provided you can see the ground, this can be calculated accurately and the necessary corrections made whilst in flight. In clear weather the direction of smoke from chimneys and funnels ashore and the line of wave crests at sea, will give a fair indication of the wind's direction. Ground speed can also be accurately checked as long as fixed objects are visible on the ground and similar results can be obtained by use of special smoke bombs, etc., when over water. Experiments are being made with ground speed indicators that are not dependent on visibility but so far no practical instrument of this kind has been devised. Experiments have also been made (Major Blair) in communicating the force of the upper air currents by radio.

The point to point method is useful if flying a plane without a drift meter. This consists in picking out beforehand upon the map a number of prominent objects lying upon the map course. The necessary approximate corrections for drift are first made, and a course estimated. The pilot flies along the es-

Fig. 7. Corrections for drift and compass error. Tabulation I is for drift, tabulation II is for deviation and variation.



I

WIND		PLANE		MAP COURSE	
VELOCITY M.P.H	DIRECTION	VELOCITY M.P.H.	DIRECTION	PLANE VELOCITY ON COURSE	DIRECTION
40	18°	60	23½°	20	36°

II

MAP COURSE	MAP COURSE CORRECTED FOR WIND	MAGNETIC VARIENCE	MAP COURSE CORRECTED FOR VARIENCE	DEVIATION	FINAL COURSE CORRECTED FOR VARIATION AND DEVIATION
36°	23½°	14½° W	38°	3½° W	34½°

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timated course and notes the position of object A; (See Fig. 4) if he finds his plane either right or left of the object, he alters course accordingly, until he comes over the second object B when he should make an even more accurate wind allowance to bring him over the third point. If the objects chosen are equidistant and the pilot finds that to get from the second to the third he has to steer to the right by an amount N°, then on reaching the third point he should steer to the left by $\frac{N}{2}$ degrees.

If the three points 1, 2, and 3 are arranged so that A B=X and B C=Y, and if on arriving at B one has to correct his course by N° to the right, in order to arrive at C, then the correct course to be taken at C is such that he must steer to the left by an angle A given

$$\frac{X}{Y} = \frac{TAN\ a}{TAN(N-a)}$$

For small angles up to 10 $a = \frac{X}{X+Y} N$.

I found this formula among some notes of mine, but originally copied it from a British text book, though just which one I am not at the moment able to say. Thus I am unable to make the necessary acknowledgement. Fig. No. 6 gives further examples of drift.

A book could be written on drift problems alone, but if in this article I have in any way emphasized the importance of navigation to any fledgling and given him a better idea of some of its peculiar difficulties and taken him just one small step towards a good working knowledge of aerial navigation, I am satisfied. Later on, I hope to deal in detail with charts and maps and navigational instruments, and finally with the simpler problems and short cuts in aerial astronomy.

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Patent Department

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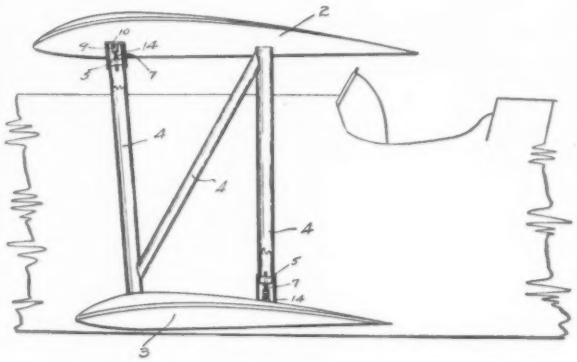
No. 1,695,611, ADJUSTABLE AIRPLANE STRUT TERMINAL, Patented December 18, 1928, by John C. Sanders, of Seattle, Washington, Assignor to Boeing Airplane Company, of Seattle, Washington.



A principal object of the invention is to so construct and relate the elements comprised in the strut fastening means as to provide a simple, efficient, and inexpensive device which will greatly facilitate rigging because of its range of adjustability after the strut has been mounted to the wing structure, thus eliminating the necessity of removing the strut in order to adjust the terminal, either for aligning the ship in the process of rigging, or for incidence or dihedral alteration.

No. 1,696,404, AEROPLANE, Patented December 25, 1928, by Peter G. Kluse, of Los Angeles, California.

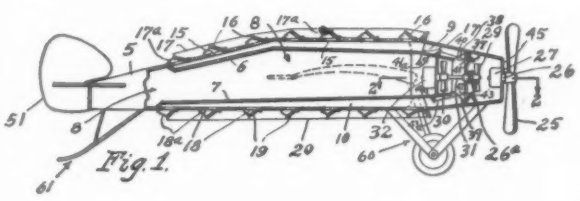
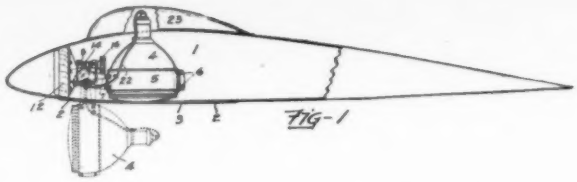


Fig. 1.

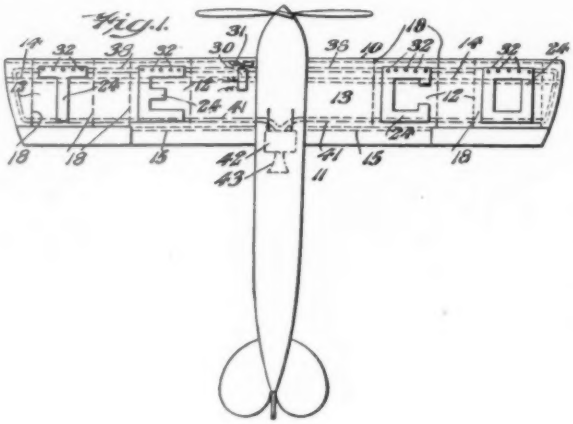
This invention comprises an aeroplane having a fuselage provided with longitudinally extending partitions to form with the fuselage a plurality of superposed air containing chambers, in combination with means for entraining air into said chambers through the fuselage wall for the purpose of directing the currents of air thus formed in such a manner as both to stabilize the machine and control the altitude and propulsion thereof.

No. 1,694,889, RETRACTABLE LIGHT FOR AIRCRAFT, Patented December 11, 1928, by Charles N. Monteith, of Seattle, Washington, Assignor to Boeing Airplane Company, of Seattle, Washington.



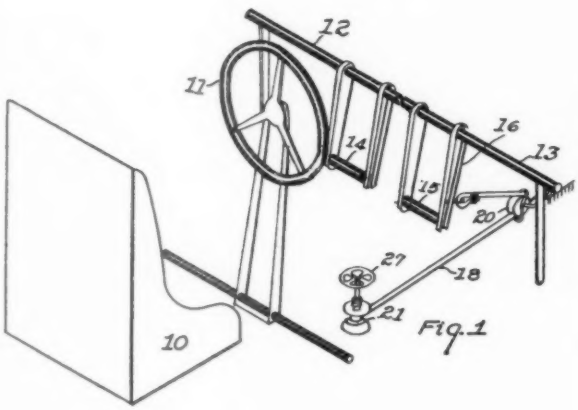
A retractable landing light, usually in the wing surface, but which may be swingably operable from within any of the principal structural portions of airplane and controllable from the operator's compartment.

No. 1,695,078, AIRPLANE ADVERTISING DEVICE, Patented December 11, 1928, by Leo Barker, of Wayne, Pennsylvania, Assignor to Starlighters, Inc., of Philadelphia, Pennsylvania, a Corporation of Delaware.



Means of displaying illuminated characters upon the wing surfaces of an airplane so that such characters will be clearly legible and distinguishable at all regulating flying altitudes. The illuminated characters are arranged within the confines of the wing surface and means are provided for preventing the heat from the lighting units from causing fire.

No. 1,695,114, AIRPLANE CONTROL, Patented December 11, 1928, by Clifford J. Leisy, of Cleveland, Ohio, Assignor to the Glenn L. Martin Company, of Cleveland, Ohio, a Corporation of Ohio.



An airplane pedal control designed to overcome the tendency to turn or "yaw." Resilient means are provided for maintaining a pressure or pull upon a foot pedal which may be adjusted to meet the requirements under any given set of conditions.

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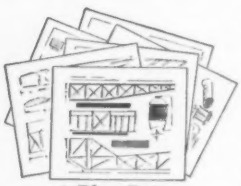

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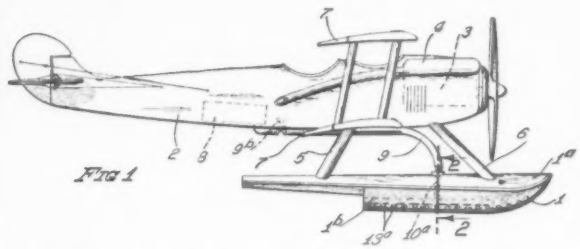
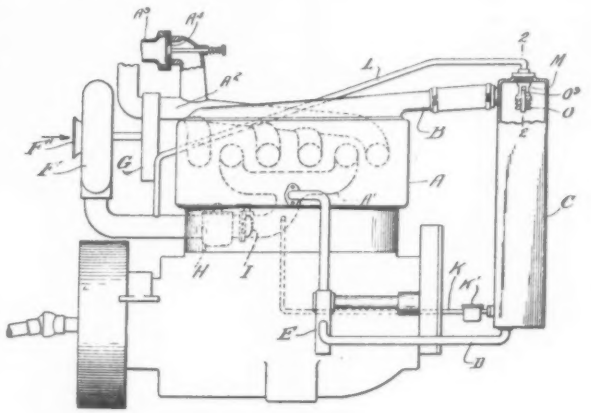
No. 1,693,773, AIRCRAFT PONTOON APPARATUS, Patented December 4, 1928, by James B. Anderson, of San Diego, California, Assignor of one-fourth to L. S. Murray, of San Diego, California.



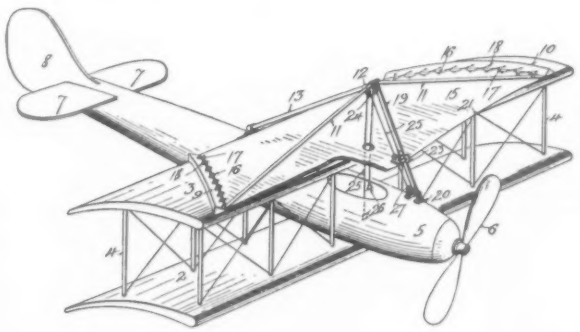
A seaplane float which will reduce the lift required to raise a seaplane from the water and which is adapted to agitate the water under it, thereby reducing adhesion.

No. 1,694,071, COOLING SYSTEM FOR AIRCRAFT ENGINES, Patented December 4, 1928, by Harry C. Mallory, of New York, N. Y.; Sue R. Mallory, administratrix of said Harry C. Mallory, deceased.



A cooling system that will operate independent of the varying pressure of the atmosphere as the altitude of the aeroplane varies. The cooling liquid is vaporized by the heat in the engine and the vapor thus generated is condensed in a suitable condenser from which liquid of condensation is returned to the engine.

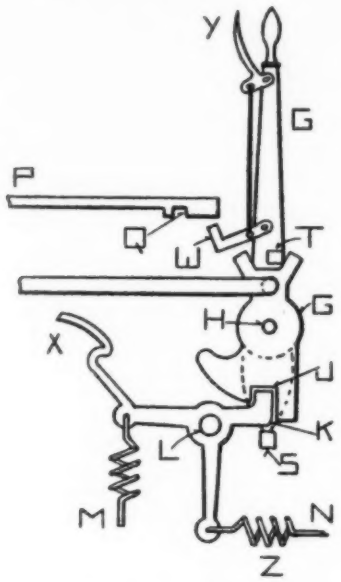
No. 1,694,177, AEROPLANE, Patented December 4, 1928, by Sigmund Horn and Maximilian Zipkes, of New York, N. Y.



A safety device which it is claimed will protect the craft against a nose dive. The invention consists in applying to the wing surface a sheet of material folded down flat against the surface of the plane, to be lifted or separated from the

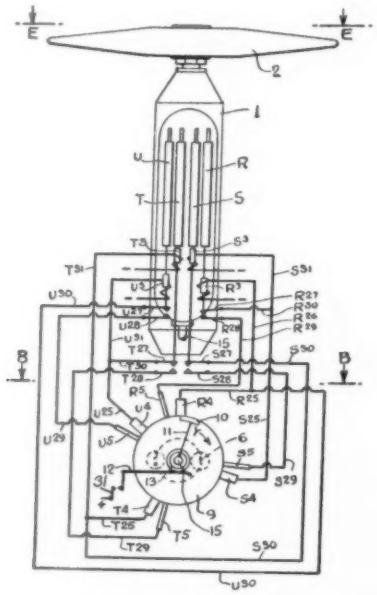
plane when necessary to form a pocket through which the air rushes between the plane and fabric.

No. 1,694,220, Reversing Propeller Throttle Control, Patented December 4, 1928, by Charles F. Jenkins, of Washington, District of Columbia.



This patent is supplemental to the device shown in previous patent No. 1,634,904 and provides for reversing the pitch of the propeller blades after the plane has touched the ground and then opening the throttle of the motor to give reverse power to the propeller, thereby introducing a delay and prompt stopping of the aircraft.

No. 1,694,488, Synchronized Machine Gun for Airplanes, Patented December 11, 1928, by Oscar A. Ross, of New York.



A modification of the invention disclosed in prior patent No. 1,454,137, the present improvement having been made as a result of further development in aircraft. The primary object of the invention is to provide means for automatically

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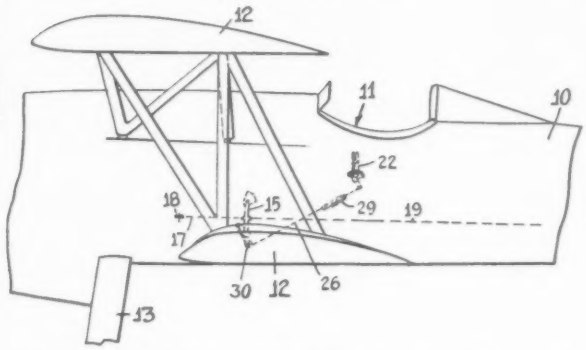
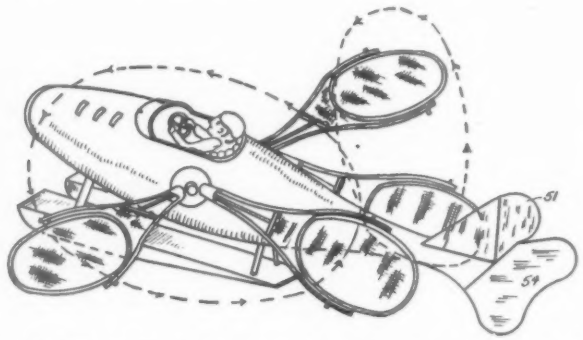
varying the time of firing of machine guns, whereby the bullets will pass between the blades, irrespective of the speed at which the propeller may be revolving.

No. 1,694,496, RUDDER OPERATING MECHANISM FOR AIRCRAFT, Patented December 11, 1928, by Theodore P. Wright, of Port Washington, and William Wait, Jr., of Garden City, New York, New York, Assignors to Curtiss Aeroplane & Motor Co. Inc., a Corporation of New York.



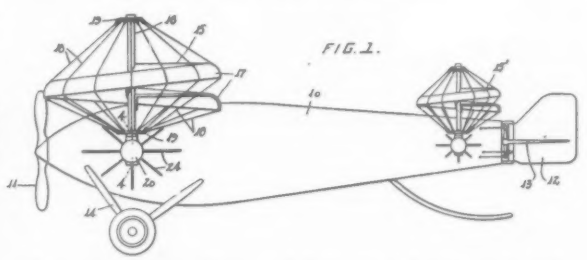
An auxiliary control operating in conjunction with an ordinary control to exert on the rudder or other control surface of the aircraft a constantly increasing operating force tending to continue its movement in either direction immediately such movement is initiated by the ordinary control.

No. 1,694,602, PROPULSION MEANS FOR AIRCRAFT OR THE LIKE, Patented December 11, 1928, by Richard Nuttall, of Sydney, New South Wales, Australia.



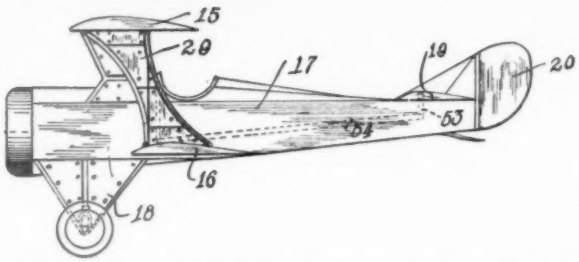
In this patent the inventor has endeavored, by a radical design, to avoid the slip and loss of motive force usually encountered, by creating partial vacuum rearwardly and direct pressure forwardly of the planes or blades, attaining in his construction the effect of a wing motion without the detrimental effect of flapping.

No. 1,694,880, AIRCRAFT, Patented December 11, 1928, by Jesse D. Langdon, of Los Angeles, California.



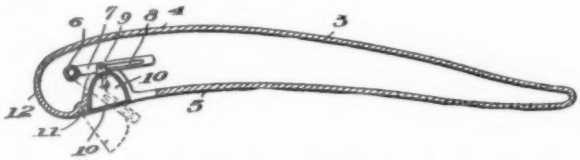
A combination airplane and helicopter, having helices for lifting the aircraft vertically, and which are also used as wings when the aircraft operates as an airplane.

No. 1,696,493, AIRPLANE. Patented December 25, 1928, by Willy Lenert, of Chicago, Illinois.



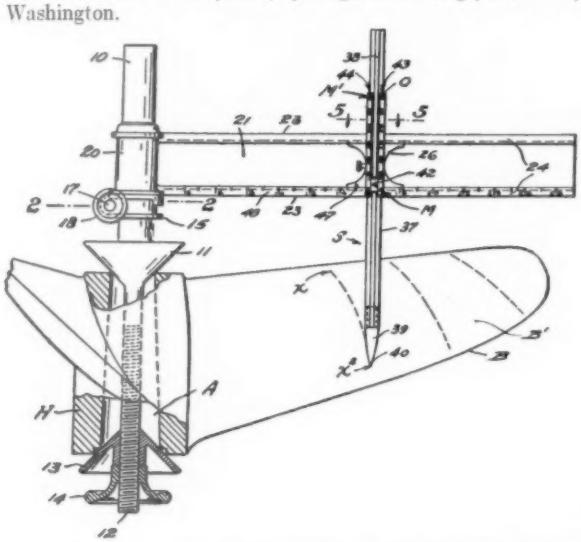
A patent which relates particularly to the wing and stabilizing surfaces and controls for airplanes. The wing stand is built up of spacers and tubing and means are provided for quickly adjusting or attaching the wing panels to the fuselage and central panel.

No. 1,696,521, RETRACTABLE LANDING LIGHT, Patented December 25, 1928, by William H. Capell, of Aberdeen, Maryland.



A retractable landing light, actuated at will by the pilot, the light, when retracted, conforming substantially to the surface of the aerofoil to which it is applied in such manner that the aerodynamic qualities of the aerofoil are not impaired.

No. 1,696,525, PROPELLER BLADE MEASURING INSTRUMENT, Patented December 25, 1928, by Leigh H. Coolidge, of Seattle, Washington.



An instrument which is adapted to be conveniently employed to accurately and expeditiously measure helical surfaces and more especially the surfaces of propeller blades for aircraft to ascertain the helical pitch.

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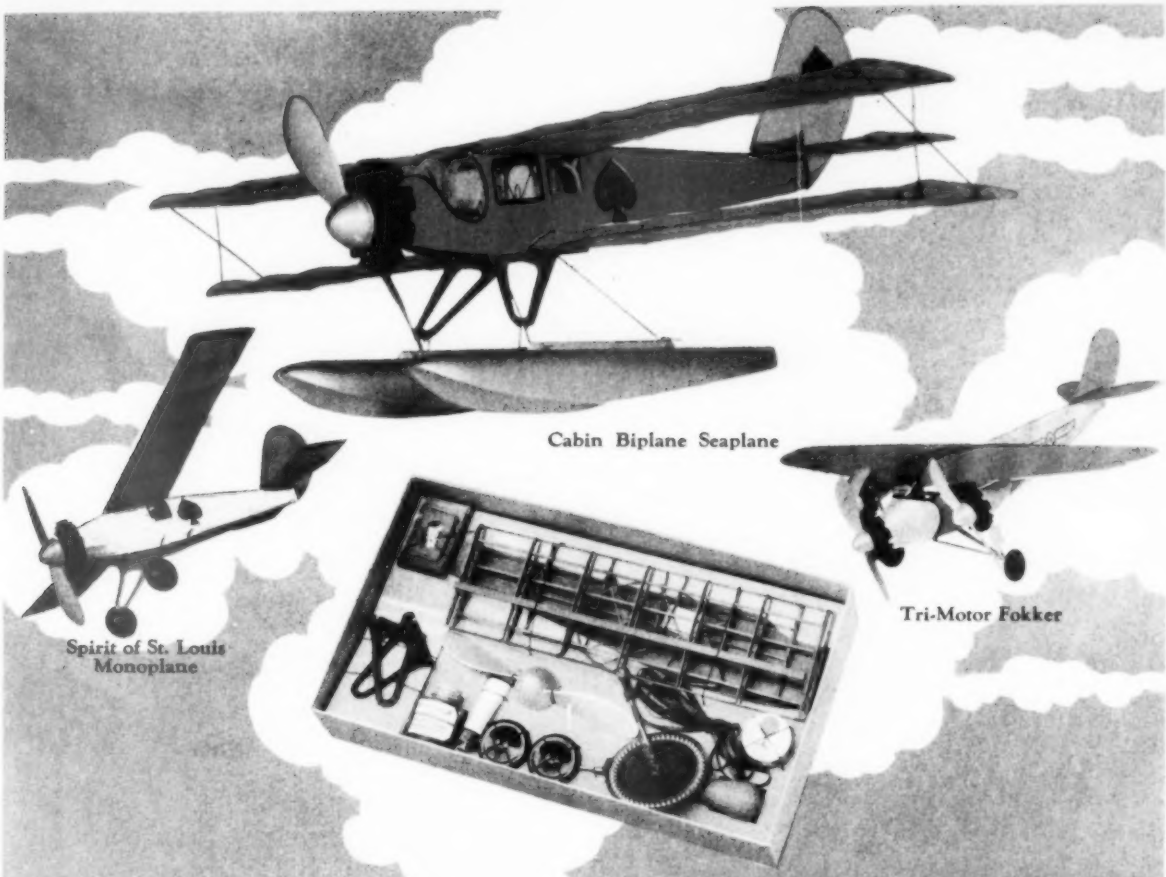

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